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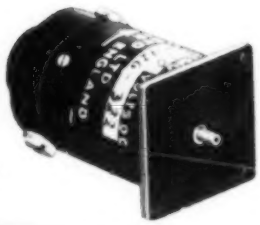

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Sq. mtg. flange—3.110" 3.110"
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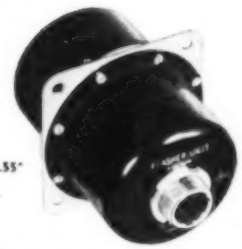

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Operation Britain's function is not to preach, but to inform: not to exhort, but to encourage every member of our close-knit nation, each one of whom has a part to play in shaping our future That future —if we all build together—is bright with promise.

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1 *To make clear the importance of thriving successful industry throughout the country, and, through it, an ever expanding export trade, if our present standard of living is to be maintained and raised still higher.*

2 *Further, to demonstrate the essential interdependence of our people of every type and occupation—men and women, young and old—who, in times of national emergency, have invariably shown their unity and determination.*

3 *To ensure that our own people—while made aware of our shortcomings—shall have the widest possible knowledge of our national achievements in the social, cultural, scientific and industrial fields.*

4 *To publish, from time to time, factual statements regarding our successes in overseas markets, and actively and positively to counter misrepresentations of Britain which are damaging to our national prestige, and thus, to our commercial opportunities.*

5 *To ensure that people throughout the world are no less well-informed than those at home regarding our national achievements in every field of human endeavour, and thereby to heighten the prestige of British products in vital export markets.*

6 *Thus, to reawaken pride in Britain's position in the world as a powerful force working for the good of all peoples and, through this more favourable climate of opinion, to raise further the morale of all engaged in commerce and industry.*

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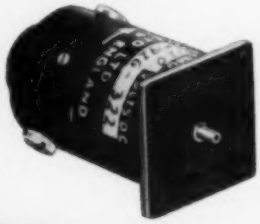

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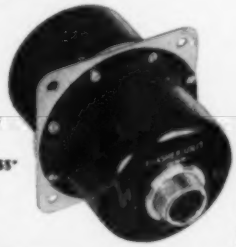

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BASIC DESIGN OBJECTIVE:

Economically Sound—for "Turbine-Age" Short-to-Medium Haul Airline Operations!

Why Emphasis on Sound Economics?

The Airline Enigma—"Profitless Prosperity"

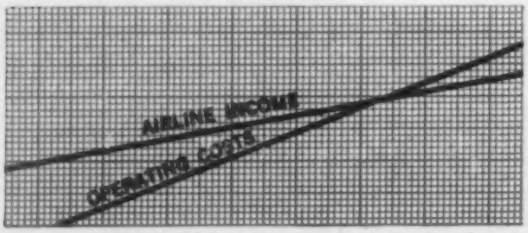
Today, airlines in all parts of the world face a unique dilemma. Traffic and gross revenue are growing rapidly. *But* costs of operation are growing even *more* rapidly, shrinking or even wiping out profit margins.

Airline directors, management, banking firms and government agencies are confronted with this problem at a time when airlines face monumental *new capital costs* in re-equipping for the turbine-age.

The Importance of Sound Aircraft Economics

Passenger-airplane economics involve two interacting groups of factors: (1) First costs, flight and maintenance costs, overhead. (2) The airplane's payload and revenue potential at pre-fixed rates.

This relationship establishes the relative profitability of any airplane.

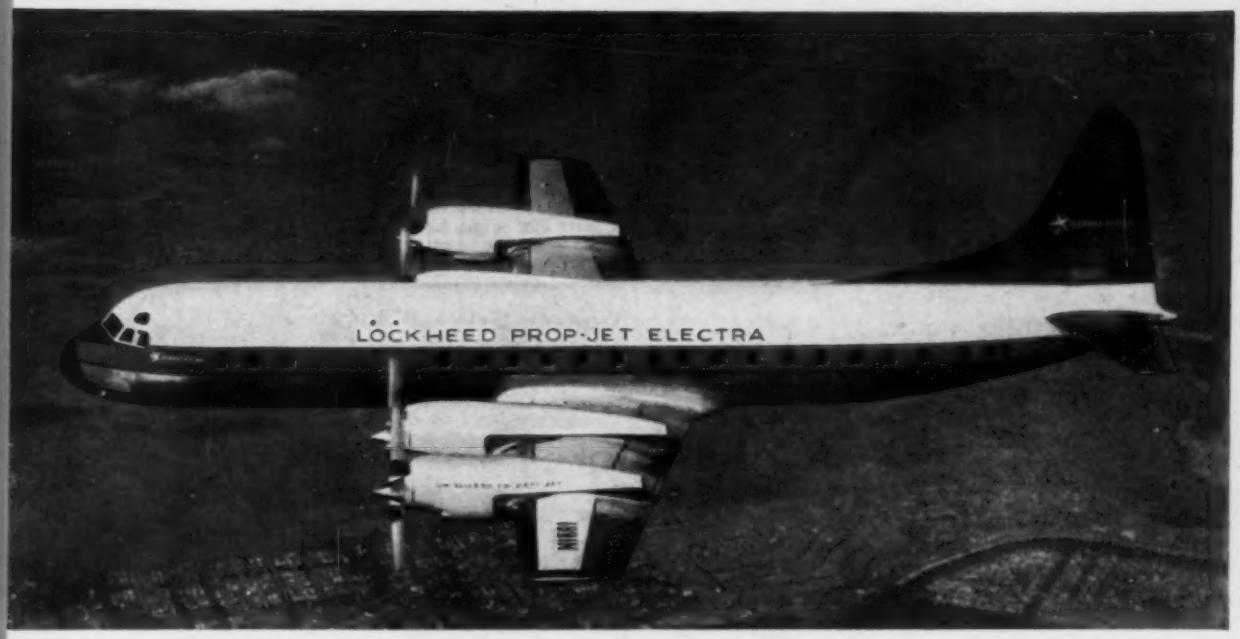


However, analysis of an airplane's relative profitability is valid only when these economic factors are applied to the specialized "use and environment" in which it will operate.

Airline "uses and environments" divide into three basic patterns. The clearly defined "long haul" and "short haul" ... and the less clearly defined "medium haul".

"Short-to-medium hauls" generate 35% to 65% of all the world's air traffic. However, overhead and operating costs are relatively higher in this area because of shorter flights, comparatively more time spent on the ground *and* higher passenger unit overhead.

Yet profit or loss in "short-to-medium haul" operations determines over-all airline financial success!



LOCKHEED ELECTRA – The Only Realistic Answer to the Turbine-Age Need for Sound Economics in Short-to-Medium Haul Operations.

Specific Economic Design Objective:

SIZE

Not too big to operate profitably with few passengers on thinner traffic density routes...

But big enough to operate on high density routes with frequent schedules for maximum passenger appeal.

TURBINE POWER

Turbo-prop NOT Turbo-jet, to produce wide margins of superiority in operations requiring many stops, many take-offs and landings *which require:* (1) Wide choice of cruise altitude flexibility; (2) No new techniques in air traffic control, approach, holding or landing. (3) Sure stops on short or icy runways. (4) Quick acceleration for "go-arounds". (5) Shorter maneuver times. (6) Lower "holding" altitude and costs.

SPEED

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—Ability to make many stops without en route refueling.

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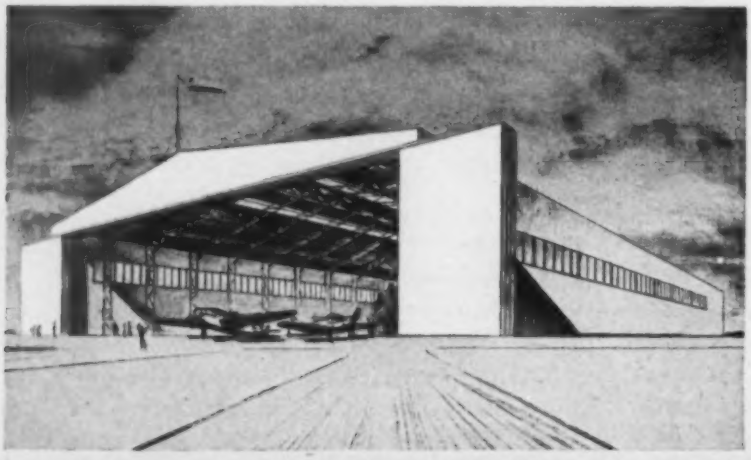

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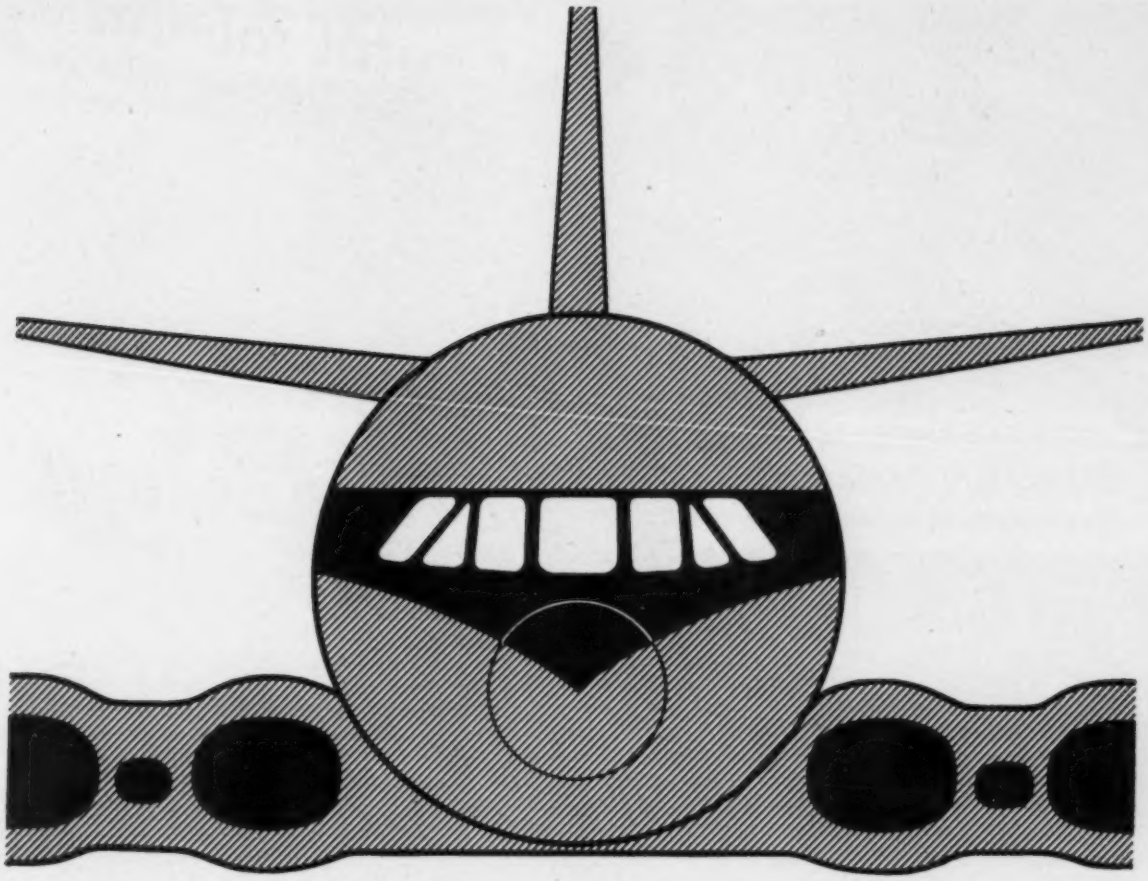

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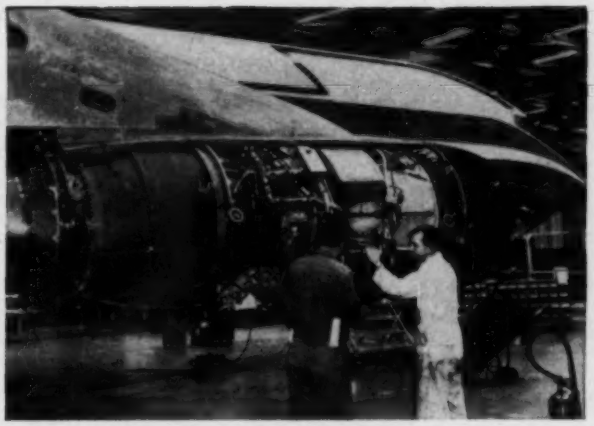
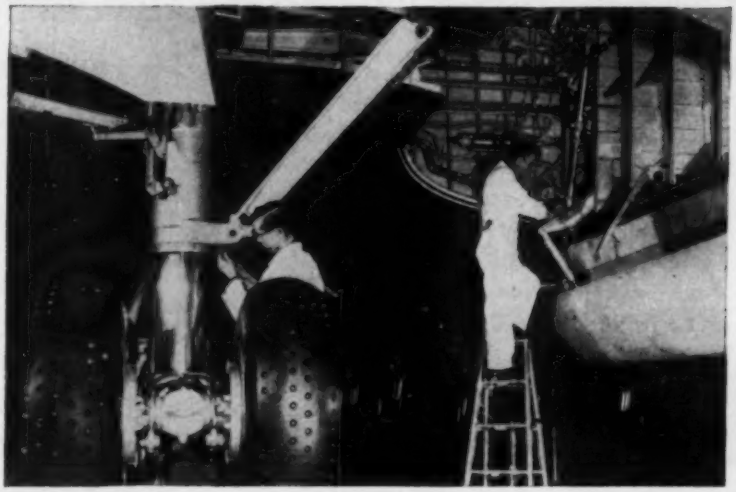


POD-MOUNTING OF ENGINES, a Boeing development, provides quick, convenient, ground-level accessibility, and permits rapid engine changes. Many Boeing jetliners throughout the world will be powered by British Rolls-Royce Conway engines.



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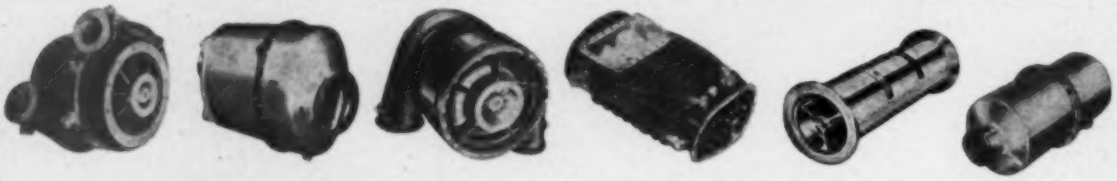

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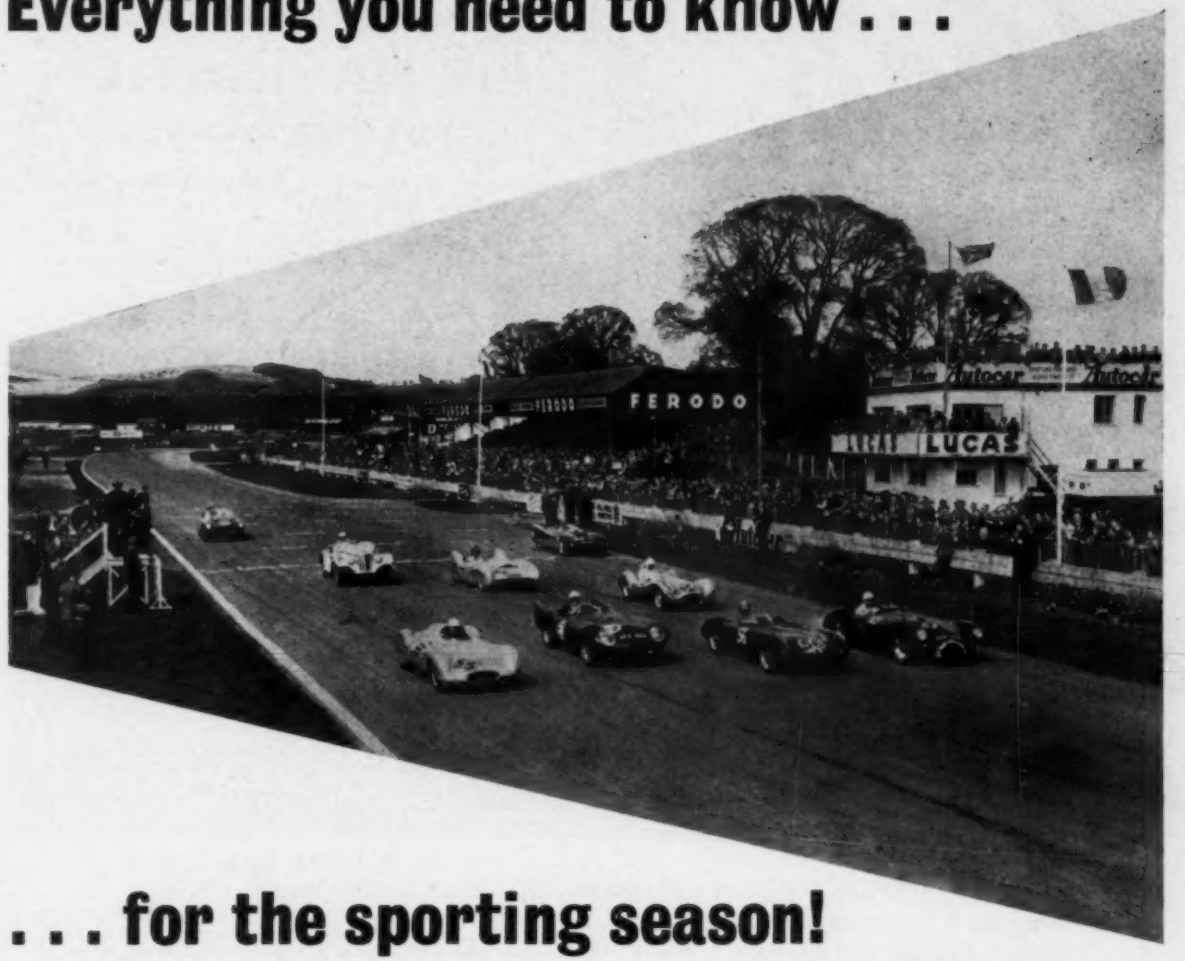

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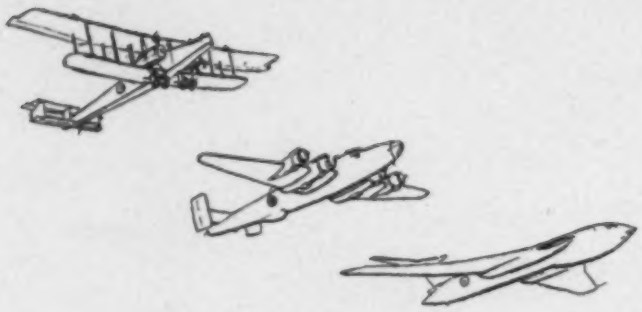

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FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

No 2566 Vol 73 FRIDAY 28 MARCH 1958

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New York, N.Y.
Thomas Skinner and Co. (Publishers), Ltd.
111 Broadway, 6
Telephone · Digby 9-1197

ANNUAL SUBSCRIPTION
Home £4 15s 0d, overseas £5 0s 0d. Canada and U.S.A. $15.00.

Second Class Mail privileges authorised at New York, N.Y.

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Missions and Missiles

BRITAIN, more than any other country, seems to have fallen into the trap of regarding military aircraft and missiles as direct competitors, fighting each other for the money available. It is instructive to turn from this thoughtless bickering and examine the "procurement policies" of the Americans.

Between them, the U.S.A.F. and Navy have 28 major weapon systems yet to enter service. It is completely incidental that nine of these happen to be unmanned, whereas in the other 19 the inclusion of a human crew has been found to be an overall advantage. Each system is the result of many thousands of man-hours of study and is as close to the optimum for its particular task as can reasonably be expected. There is no suggestion that the manned aeroplane should "give way" to the missile; such a dogmatic assertion cannot withstand examination.

One could, of course, suggest that all supersonic winged vehicles are much alike, and that the missiles merely happen to be those without a seat. But there is far more to the picture. A vehicle which contains a man may have enormous advantages over one which does not, and for some missions these advantages render the manned device the only practicable solution. Several fundamental missions will never be accomplished by unmanned vehicles unless they can be endowed with far greater intelligence than they now possess. Anybody can make a vehicle home on to a ship, or a radar station; but nobody has found a way of making a missile capable of searching for a particular land target. Likewise it is relatively easy to fire a missile which will destroy an aeroplane; but no missile at present in prospect can inspect an aeroplane and decide whether it is friendly.

Many people in high places would do well to remember these points. It is easy to be led astray by the fact that, for certain clearly defined missions, it is an advantage to dispense with a crew. Maj-Gen. James Ferguson, director of requirements of the U.S.A.F., puts the case logically: "A balance of missiles and aircraft of varying performances is needed to produce the greatest threat to an aggressor and the one most difficult to defend against."

We say again that the famous, or infamous, White Paper by the British Ministry of Defence in April last year merely provided an essential jolt; it should not, and could not, have signified any sudden lack of interest in manned aircraft. Britain will have to have manned military aeroplanes for years to come; and somebody had better start ordering them.

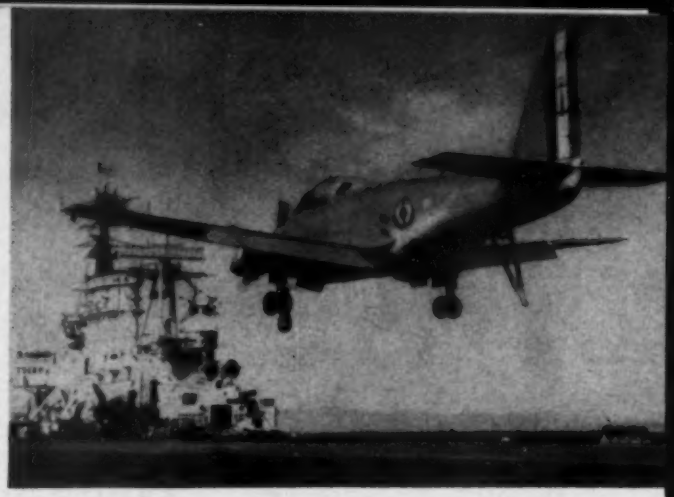
Due Credit: Due Thanks

A FEW weeks ago *Flight* was invited to endorse the proposition that American flying journals had deliberately sought to smirch the reputation of British aircraft. We found ourselves in the happy position of being unable to oblige; and the proposer went his way disgusted.

True, there have been occasions when we have yearned to "reorientate" our opposite numbers on some particular aspect of the British aeronautical scene; and we remember shop-sessions with American journalists in *Flight's* Farnborough caravan when the atmosphere has been red, white and blue with our protestations. But in general the British aircraft industry has been accorded fair, if unsparing, comment in the responsible U.S. journals. We recall especially an assessment by Dave Anderton, of *Aviation Week*, in one of his post-Farnborough reports. He reported that the P.1 is the first of the post-war generation of military aeroplanes designed in Great Britain that can be compared favourably on overall performance with its contemporaries in the United States. Which is precisely true. Mr. Gill Robb Wilson, editor and publisher of *Flying* magazine, has struck up the band for British aeroplanes on his own resounding note. Thus, of the Vulcan, he says that it is "in operation, while our B-58, albeit superior in promise, is still several years away from squadron activity." And of the Scimitar he reports that it has exceptionally slow landing characteristics and is a "thought-provoking effort in naval hardware."

To Messrs. Anderton and Robb Wilson best thanks for a fair crack of the whip. And congratulations on their professional acumen.

FROM ALL QUARTERS



ALIZE ALIGHTS: Like the Fouga C.M.170M Magister Marine, the Bréguet 1050 Alizé anti-submarine aircraft (Rolls-Royce Dart 521) was put through simulated deck trials at R.A.E. Bedford. Both types then completed qualification from H.M.S. "Eagle," here seen accepting an Alizé off the Riviera coast.

Premier on Nuclear Weapons

IN his Parliamentary statement on March 18 about the carrying of nuclear weapons by aircraft flying over the United Kingdom the Prime Minister said that these were only carried on special operational exercises or on training exercises when it was necessary to move the weapons with their aircraft from one airfield to another. Bombs carried on such exercises were never ready for instantaneous use, and arming them required an elaborate procedure by the crew.

In answer to questions, Mr. Macmillan said that to prohibit the carrying of these weapons would limit the value of the work done in training. Dummy bombs were used so far as possible; but it was necessary for air and ground crews to handle real but unarmed bombs in exercises so that they could do the job efficiently.

In a recent statement about U.S.A.F. aircraft carrying nuclear weapons on flights over Canadian territory the Canadian Minister of National Defence, Mr. George R. Pearkes, said that "on certain occasions" B-47s and B-52s of Strategic Air Command had carried out training flights over Canadian territory with nuclear weapons aboard; but these flights took place only with the express and prior permission of the Canadian Government in each instance. Only in situations of immediate danger and grave emergency would aircraft armed with nuclear weapons fly over Canadian territory under present Canada-U.S.A. defence agreements.

RA.29 Approved for Civil Operation

THE Rolls-Royce Avon RA.29 has been given full normal-category approval by the A.R.B. for use in civil aircraft. Rated at 10,500 lb thrust, it was tested in accordance with the requirements of the combined U.S./U.K. civil type-test schedule, and will power the de Havilland Comet 4 ordered by B.O.A.C. (see p. 420), the Comet 4B for B.E.A. and the Sud-Aviation Caravelle ordered by Air France, S.A.S., Varig, Finnair and Air Algerie.

RA.29s operated by B.O.A.C. in Comet 2Es scheduled between London and Beirut (*Flight*, October 4 last) have been examined by the A.R.B. at 250 and 500 hr, and at 750 hr (which is the present authorized overhaul life for the Comet 2E engines); further trials have been authorized up to 1,000 hr. During the whole of the operation to date there has been one premature engine removal, which was due to a failure of an auxiliary unit.

Boscombe Down's Future

TWO disquieting statements were made at the annual aircraft contractors' dinner at the Aeroplane and Armament Experimental Establishment, Boscombe Down, last week. Air Chief Marshal Sir Claude Pelly, Controller of Aircraft, M.o.S., said that there would be a great deal of work for the Establishment for the next two-and-a-half to three years; after that, its energies might be turned to the testing of civil aircraft. The shock of last year's White Paper had, nevertheless, resulted in a more forceful and sensible approach to manned aircraft.

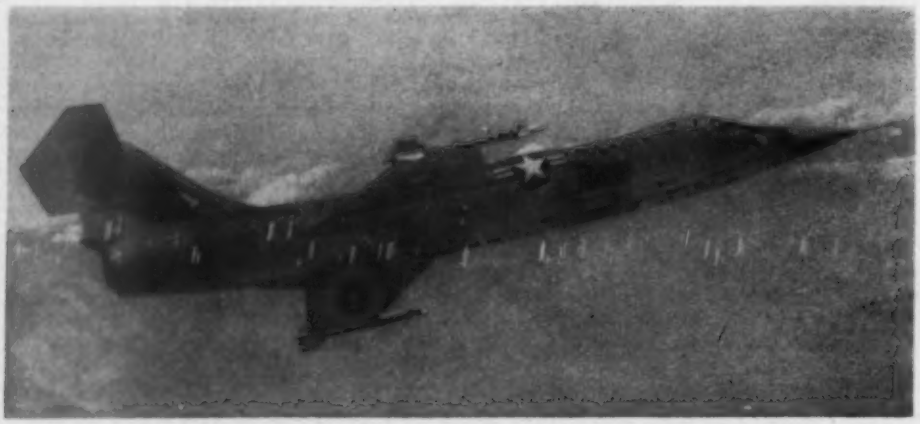
Mr. C. F. Uwins, managing director of the Bristol Aeroplane Company, said that unless orders were placed soon the industry would be paralysed and would not be able to recover. Policy might be dictated by geography and finance, but some decision was needed soon; both the R.A.E. and the A. and A.E.E. would "become monoliths" unless something were done.

Forty-Four Years of Design

A SOUVENIR book, possibly unique in artistic merit and entitled *This Is Your Life*, has been presented to Mr. George Stannard, on his retirement from Vickers-Armstrongs (Aircraft), Ltd., after 44 years of service. It was inscribed by numerous colleagues.

Mr. Stannard.

After serving an apprenticeship Mr. Stannard joined Vickers' plant and building drawing office before being transferred to the aero shop as assistant to the manager. He was very soon concerned with the design of jigs and tools for the Gun Bus (the First World War having just started). In 1915 the aero drawing office, then at Broadway, Westminster, was moved to Crayford and Mr. Stannard was shortly afterwards transferred to it as a draughtsman. The design office was moved to Knightsbridge in 1917, when Mr. Stannard became a section leader, engaged on developments of well-known Vickers types and little-known designs such as the F.T.2 triplane bomber. In 1919 the office was much reduced in size and a nucleus of its staff, including Mr. Stannard, was moved to Weybridge. There he continued as a section leader until 1921, when he became chief checker. At that time Rex Pierson was chief designer and Paul Wyand was chief



FIRST PHOTOGRAPH of a Lockheed F-104A Starfighter armed with two GAR-8 Sidewinder air-to-air missiles supplementing the six-barrel "Gatling" gun. This machine is one of those now equipping the 83rd fighter/intercepter squadron stationed at Hamilton A.F.B. near San Francisco, the first unit to receive the aircraft. An F-104A recently flew supersonically for more than an hour: the powerplant is a General Electric J79-GE-3.

***BRIGANDS' FAREWELL, MALTA ASSEMBLY:** The last Bristol Brigands making a final flypast at North Luffenham on March 13 after being in R.A.F. service since 1946 and on Fighter Command navigator training duties since 1951; and below, all types of Rolls-Royce powered R.A.F. equipment based at Malta G.C. in formation with the Conway Vulcan on its recent visit to the island.*

draughtsman. Under these, George Stannard had a hand in the Viking amphibian, Virginia, Victoria, Vildebeest, Viastra, Wellesley and Wellington, as well as other less famous aircraft. He became attached to the chief designers' project office about 1946, and has since been concerned with the many tenders originating there, including those for the Viking, Valetta, Varsity, Valiant and Viscount. He was project engineer in charge of the 800 Series Viscounts and the Vanguard and the VC.10 are current types with which he has been concerned.

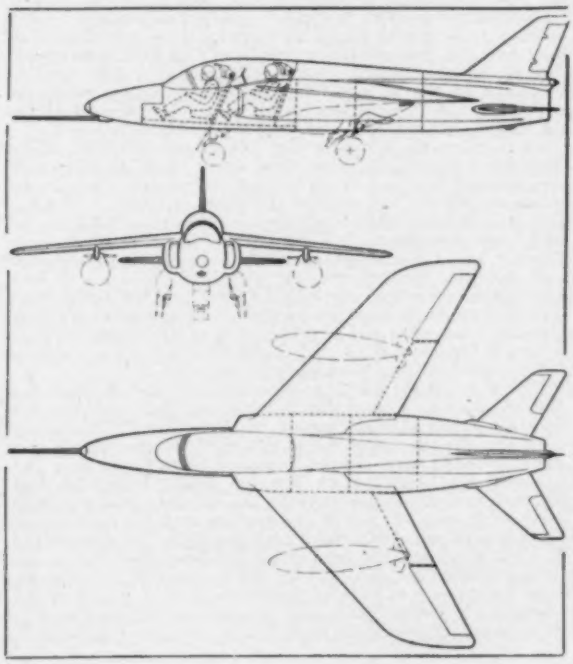
Mr. Stannard organized the adoption by the Vickers-Armstrongs Aircraft design office of the elementary mould loft from the shops, and developed it into its present imposing form—over eight times the size when first taken over. The introduction of the photoloft was also conducted under his guidance, and for the past 20 years he has been responsible for devising and organizing full-size mock-ups. Mr. Stannard represented Vickers on the Society of British Aircraft Constructors' Full-Scale Layout Committee.

D.H. Board Appointments

A DIRECTOR of the de Havilland Engine Co., Ltd., since its formation in 1944, Mr. Hugh Buckingham has been appointed managing director; he also becomes an ordinary director of de Havilland Holdings, Ltd., of which company he has hitherto been a special director. Since January 1956, when he was appointed general manager of the Engine Company, he has undertaken the duties of its principal executive. Mr. Buckingham has been with de Havilland since 1926, when he joined as a premium apprentice. He was commissioned in the Reserve of Air Force Officers in 1928 and obtained his Commercial Pilot's Licence in 1929. In the years 1930-1934 he was a demonstration and test pilot, then continued as an executive of the sales department, flying a great deal overseas, until 1939. In that year he went to New Zealand to form a new de Havilland Company there, of which he was director and general manager until 1943.

Mr. Buckingham.

The de Havilland Engine Company has also appointed Mr. M. G. Ash as financial director. A director since 1955 and secretary since 1946, he will continue to hold the latter office.



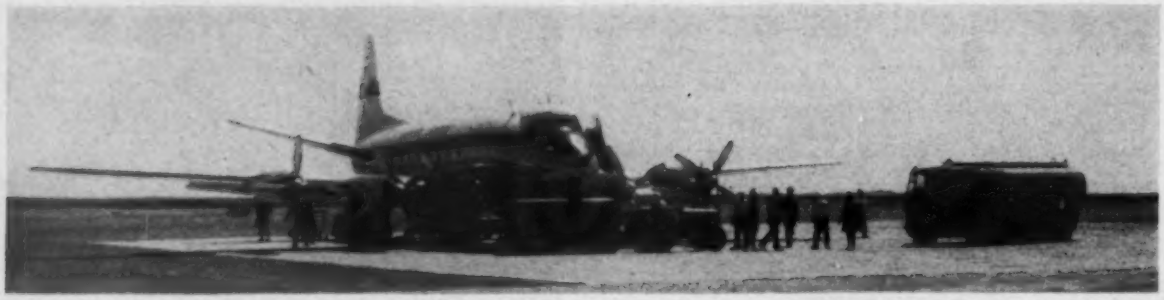
The Gnat Trainer Order

AN order worth £2,500,000 has now been placed by the M.o.S. for a development batch of 14 Folland Gnat Trainers for the R.A.F. Further orders may be expected. The Trainer project began as a private venture in 1956, and Ministry instructions to proceed with preliminary work were issued last August. Principal departures from Gnat fighter layout are set out below.

The nose has been lengthened by nine inches and the equipment bay and 20-gal fuel tank immediately behind the single-seat cockpit have been eliminated in order to accommodate pupil (in front) and instructor in tandem Folland lightweight, automatic 80 ft/sec ejection seats. The canopy is a single-piece moulding opened and jettisoned with the assistance of a pneumatic ram. The Bristol Orpheus BOr.4 trainer engine of 4,230 lb thrust provides longer overhaul life and lower fuel consumption than the BOr.3 of the fighter. Both fin and tailplane areas are slightly increased, the rudder being manually operated against centering springs and a yaw-damper. Tailplane and elevator are normally locked to act as a slab unit moved by the standard Hobson double screwjack of the Gnat Mk 1. Manual reversion is achieved by unlocking the elevator and trimming the tailplane electrically. Structure purely designed to support gun-loads has been lightened, guns removed and the gun-bays arranged to accommodate fuel. Length and height of the Trainer are respectively 30ft 9in and 8ft 6in.

The most extensive change is in the wing, which has been redesigned to provide the approach and landing characteristics required for training purposes. Span and area are increased to 24ft and 175 sq ft respectively and t/c ratio reduced to 7 per cent; but sweep, 40 deg at quarter chord, remains unchanged. Ailerons, mounted outboard, are operated by Lockheed servos; and inboard split flaps are actuated (20 deg for take-off and 70 deg for landing) by a single jack in the starboard wing-root. Four channel-section spars are located at constant percentage chord and are covered over each semi-span with single machine-tapered skin panels. The inner portion of each wing has three additional spars and forms integral tankage for 50 gal on each side.

General arrangement of the Gnat trainer, described here.



Hunting-Clan and Airwork's 52-seat Viscounts have brought a new touch of luxury to the Safari service to East Africa. Here a return flight from Kenya refuels in the actinic glare of the sun-baked apron at Khartoum.

SAFARI ADVENTURE

Air Transport's Part in an Embryo Tourist Industry

By A. T. PUGH

"I THINK," said the game warden, "that a guard on the aircraft *would* be wise. You can never tell when one of these Masai tribesmen fellers might try their spears on a tyre." Nothing could have brought home to me more forcibly the realization that—24 hours out from London and 45 minutes by air from Nairobi—safari adventure among the animals and native inhabitants of Kenya's game parks and reserves awaits visitors to the Crown Territories with only limited time and means to spare.

There is a distinction between these protected areas; the parks (such as the National Game Park immediately outside Nairobi and almost bordering the new international airport at Embakasi) are kept strictly for game, but in the reserves only the shooting of game is prohibited; migratory movements are left unchecked and the native tribesmen graze their cattle across a thousand square miles or so of game reserve. Indeed, the country is theirs, and the major part of the entry fees for a day's big-game camera hunt by Land Rover, or for a more protracted touring safari, goes to them. In Kenya's Amboseli game reserve, overshadowed by the equatorial snows of Tanganyika's Mount Kilimanjaro, the Masai tribesmen are not above spearing an occasional lion-cub or rhino (or perhaps, even, as the warden suggested, a visiting DC-3); and they wage a constant minor war against the restraint imposed on the killing of game. They are obliged to guard their herds against marauding lion, and if an occasional cow is taken—well, what better excuse could there be for a little surreptitious spear practice as compensation?

Any visitor to the Kenyan game reserves can perhaps really appreciate the natural wonder of what he sees around him only by understanding a little of the problems of wild-life preservation. The Masai tribesmen at Amboseli are not by any means the only game hunters who, if left unchecked, would decimate Africa's game population; but their excuses for doing so border on the ingenious. The warden at Amboseli (a man dedicated to his work of preservation and protection and the only person I have met who keeps a grown lion as a pet) recounted a tale of Masai youths who—a little drunk from a Saturday spree—allowed their donkeys to stray into the bush. They were rounded up by the warden's askaris and herded back to the camp that serves visitors to the reserve. On the way the donkeys took fright and bolted and, after dark, fell prey to the lions. The following day the Masai demanded the return of their motor cars (to use the translation of, I think, the Masai word for "transportation system") in the fond hope that they would receive as compensation an excuse for a lion hunt.

But the importance to East Africa of game as a tourist rather than a hunting attraction is being realized more and more; the licence fees for shooting big game (they are about £75-£100 for an elephant) are now very high and the issue of licences is closely restricted. The East African territories have discovered that they have freely available, in their game reserves and enviable climate, the nucleus of what could easily become an important new industry to attract holidaymakers from the saturated resorts of Southern Europe. This potential is, for the moment, shackled by lack of money, but as an example of what can be done, on a small scale within Kenya, is East African Airway's successful regular Sunday charter service to the game reserve on Serengeti Plains. The airline is able to offer a type of one-day inclusive tour for only £6 10s that includes a 1¼ hr flight to the reserve, transport during the day, lunch and the return flight.

Just what good value this can be (28 full seats are usual on these excursions) was amply demonstrated by a charter flight I made in an E.A.A.C. DC-3 to the game reserve at Amboseli. Flying in Kenya is a stimulating experience at any time; only in the rains, or the early-morning stratus layer that is soon burned off by the sun, does the visibility drop below the crystal-clear. After taking off from the *murram* runway at Nairobi West (now renamed Wilson, after Mrs. Florence Kerr Wilson who formed, with Campbell Black, Kenya's first airline) the outward 100-mile-odd leg was flown on a V.F.R. flight plan by simply pointing the nose at the twin peaks of Kilimanjaro and switching-in the autopilot.

The airstrip at Amboseli, Oltukai (I heard the name for the first time when I arrived; so, I believe, did the crew) gave me my first taste of an outback operation. A barely-defined cleared strip on the plain formed by a dried-out soda lake, it has as its only installation a windsock. It stands in majestic isolation in a waste of flatness. At nine o'clock on the morning of our arrival, the sock hung limp and disinterested, with only an even more disinterested Wildebeest which grazed nearby for company. The standard procedure on arrival is to buzz the strip, thus announcing the arrival of the party to the warden and his guides and ensuring that the strip is clear of animal intruders.

As this was the first time that any of the crew had visited Amboseli I was not surprised when, shortly after we had landed and jumped from the door sill (some sort of airstep is going to be needed when this trip becomes a regular commercial venture), they reappeared in khaki shorts and shirts ready to enjoy the day with their passengers. I learned from the pilot, Capt. Peter Brumby, that the Corporation is filling out its charter business with the spare capacity available from nine DC-3s on its fleet. East African have been operating DC-3s since 1949 and they are now used mainly to provide a network of services between Kenya, Uganda, Tanganyika and Zanzibar, but they also operate a coastal service to Durban that has proved remarkably popular in spite of stiff competition from more modern equipment.

Part of the answer may lie in the standard of operation that East African provide. Kept smart and well-polished externally, and with a fine record of mechanical reliability, the DC-3s belie in their interiors the age of the design. It is not that the décor is madly contemporary—simple green and white paint, white curtains and simple parcels racks are used—but it is neat and glare-free and scrupulously maintained. The standard seating arrangement is 28, but 30 or even 36 seats are used for some charter operations. Some of the later aircraft to join the fleet were, in fact, new machines that had been stored for many years before they were converted for East African use by Scottish Aviation, and some have flown as little as 11,000 hr. It is all the more disheartening to E.A.A.C. that, next January, the Directorate of Civil Aviation (which closely follows M.T.C.A. practices) is to introduce

Domestic operations within the East African Crown Territories are flown by East African Airways' DC-3s and Dominies. Sagana II, on the right, was used by H.M. the Queen in Uganda in 1954.

(Left) East African Airways' DC-3 operations are based at Wilson airport, Nairobi. The terminal building is the friendly meeting place for club, charter and Police Air Wing staff. (Right) Safari night stop: an annexe to the Nile hotel at Wadi Halfa is this houseboat on the river.

the new W.A.T. (Weight, Altitude, Temperature) curve limitations. Operating from Kenya's high airfields (Nairobi's airports are all over 5,000ft and others on the DC-3 routes are even higher) in noon temperatures, the effect on payload will plunge the operation below the economic level that (with some assistance from B.O.A.C.) had been painstakingly achieved and tenaciously held. Even Embakasi's 10,000ft runway will not entirely relieve the W.A.T. restrictions at Nairobi and lengthening of other runways —though urgently pleaded by E.A.A.C.'s board—can hardly be justified on the amount of traffic carried.

Many of the Corporation's services are provided simply as communication lines to communities such as those at Soroti, Lira, Gulu and Arma which are served by Rapide (the Corporation name is Dominie) at totally uneconomical frequencies and load factors. No amount of fare reduction will attract much more traffic upon these routes for several years to come, and it reflects credit on the Corporation that they achieved even a slender book profit in their overall operations last year. It is hard to see how this state of affairs can continue. Perhaps the only solution, and certainly one which the airline is examining very closely, is re-equipment with more modern aircraft than Rapides and DC-3s; the Canadairs present another problem again.

East African Airways have, in fact, already made an attempt at replacing their Rapides with the Macchi 320. For various reasons the Italian aircraft was not very suitable for the airline's needs, although a metal aircraft with five seats or so, reasonable freight capacity and an ample ceiling comes as near as anything to meeting the sort of specification that the Corporation have in mind. The Macchi was later sold to Campling Brothers and Vanderwal who use it for charter operations throughout East Africa.

The problem of finding a DC-3 replacement is perennial. I gained the impression that East African would welcome an opportunity of bringing their fleet up to date by operating a turboprop, but I was reminded again and again that money for expensive new equipment simply is not available. The Friendship had been closely considered, but was regarded as being too expensive, Viscounts would be too large at this stage of Kenya's domestic air-route development (although they have an obvious potential on the DC-3 coastal route through Dar-es-Salaam and Mozambique to Durban) and the first cost is more. The Dart Herald is being watched with interest; for although it is a new aircraft (I do not think that East African would consider operating anything which had not many hours of airline experience behind it) it might possibly fit the bill. But there is a very natural reluctance to dispose of the DC-3s which, on almost entirely daylight operations last year, achieved an average utilization of about 1,800 hr. Perhaps the eventual answer might be to buy some of the Convair 240s and 340s that are coming on to the market, and as a short-term solution modify the DC-3s to "Super" standard.

It is perhaps too early yet to assess in detail the results achieved with E.A.A.C.'s Canadairs, which are operated in pool with B.O.A.C. (For the first six months they were worked by B.O.A.C. crews.) Three of these aircraft are in service. They are C-4s, and practically identical, even to colour schemes, with B.O.A.C.'s Argonauts; and they were transferred to E.A.A.C., "through the good offices of B.O.A.C.," at a price substantially less than £100,000 each. The fourth is to be delivered next month. They are filling a steady demand for seats between East Africa and London and East and South Africa, and on September 15 last year the Eastern Canadair services through Aden to Karachi and Bombay were inaugurated. Each service is flown once weekly and each caters for different forms of traffic. That to India and Pakistan serves the Asian population (there are three times as many Asians as Europeans in Kenya) which largely constitutes the country's traders. To South Africa go holidaymakers, honeymooners, businessmen and a growing number of South Africans and Kenyans who have reciprocal interests. The heaviest traffic is carried on the London route; employees on contract and their families going out or returning to the U.K.; businessmen concerned with Kenya's agricultural and engineering industries; salesmen, holidaymakers and so on.

There are two alternative routes to London and several more (for instance, those of S.A.S., South African Airways and Alitalia) into Europe. London traffic is mainly shared between East African Airways and B.O.A.C.'s Argonauts, B.O.A.C.'s Britannias on through services to the Union (the Corporation transferred back to Nairobi from Entebbe in Uganda, when the new airport at Embakasi was opened), and by the joint Viscount Safari service operated by Airwork and Hunting-Clan.

Having now travelled by each route—by E.A.A.C. from London and home again by Airwork—I don't think that it is possible to say that one service is preferable to the other. For regular travellers between Kenya and the United Kingdom, for those returning from leave or for anyone in a hurry, the direct Rome-Benghazi-Khartoum-Entebbe-Nairobi service is likely to be the more attractive. And in the adequate four-abreast comfort of one of the Argonaut's 54 tourist-seats, with 40-minute interludes for leg-stretching and souvenir hunting at *en route* airports of varying climatic suddenness, it is surprisingly easy to forget the rival attraction of more modern equipment operating over the same route. E.A.A.C.'s Argonaut traffic is protected to some extent by their pool agreement with B.O.A.C., but with the replacement of all B.O.A.C. Argonauts by Britannias next February, the E.A.A.C. equipment position will be relatively worsened.

It may be that another special-price transfer of aircraft between the Corporations will take place some time before B.O.A.C. starts to operate its Comet 4s through Nairobi on the South Africa run in early 1960. B.O.A.C.'s plans for introduction of the Comet would appear to make a Britannia 102 sale feasible, and East African would eagerly welcome turboprop equipment on their London, South African and Eastern routes.

When Airwork and Hunting-Clan introduced turboprops on to their East African Safari service in October last year they unquestionably lifted the standard of the service into practical parity with—if not similarity to—the direct tourist services operated by B.O.A.C. and E.A.A.C. Yet there is a certain light-hearted enjoyment to be gained from the Safari service that is not engendered only by clever advertising; it may be the "something-for-nothing" feeling of flying in a turboprop at £20 less than the Argonaut return tourist fare, or it may be the prospect of a transit night-stop. In some ways this is perhaps just as well: during the four months when the tiny desert flies are blowing in off the Nile, Wadi Halfa is hardly a holiday resort. But it has a Nubian fascination that asks only to be regarded with a relatively uncritical holidaymaker's eye, and landing there in the late afternoon earlier this month I found it pleasantly cooler than the searing wind-tunnel blast of heat at Khartoum 380 miles to the south. When negotiations are finalized with the Egyptian Government, the night stop will be made at more pretentious (to avoid the obvious pun) Luxor.

Whatever arguments are advanced about the generation of new traffic by the Safari operation, it is a fact that the night-stop service is partly self-defeating. It probably *does* carry a greater number of first-time passengers than is carried by the Corporations, yet when the experience of an *en route* stop has once been enjoyed, part of the fascination is lost in the repeat performance. Airwork would, I gathered, probably welcome the opportunity to operate on the East African route the type of tourist service (at tourist fare) that the independence of Ghana has given them on the West African route; they are not at all convinced that the key to profitable operation lies in reduced fares.

Kenya has staked—and staked high—for its place in world civil aviation. It does not seem unreasonable to predict that, given political peace in the next few years, the next decade or so may see East African safaris offered as a popular tourist attraction by European travel agents. Certainly the air services to the East African territories are prepared to meet the demand and the mounting internal traffic would be a valuable addition to the persevering national carrier.

SEEN AT BRUSSELS: One of C.S.A.'s three Tu-104s, which are due to inaugurate a service from Prague next Tuesday (April 1). The aircraft also visited London last week.

HERE AND THERE

Swiss Fighter Vote

ON March 19 the Council of States, upper house of the Swiss Federal Parliament, approved a total credit of 441m francs (£36,750,000 sterling) for 100 Swiss-built P.16s to be powered by Armstrong Siddeley Sapphires which are to be built under licence in Switzerland. The amount voted for the engines totalled 34m francs (£2,800,000).

Indonesian Operations

AMONG aircraft used by the Indonesian Air Force during recent operations in Sumatra have been P-51 Mustangs and B-25 Mitchells taken over from the Dutch several years ago. The Air Force has recently received eight Grumman Albatross amphibians and is to get an unspecified number of Fairchild C-123 Providers.

German F.A.A. Sqns.

EARLY in May the first two squadrons of the German naval air arm whose personnel have been trained in this country are due to form at Eglinton (Gannets) and Lossiemouth (Sea Hawks). They will work up at those stations under R.N. supervision and leave later this year for Germany. Sea Hawk pilots are now being trained at R.N.A.S. Lossiemouth and Gannet pilots by the Fairey Aviation Co. assisted by R.N. instructors. Observers and telegraphists are undergoing the regular British course at Culdrose and maintenance ratings are being instructed at various R.N. establishments and manufacturers' works.

M. Roger Druine

WE record with regret the death, on March 19, of M. Roger Druine, the French light-aircraft designer. His successful designs include the Turbulent single-seater and Turbi and Condor two-seaters, all of which are approved by the Popular Flying Association for amateur construction in this country. M. Druine, who was only 37 years of age, built his first aircraft when only 16. He was an active pilot and flying instructor as well as a designer.

Inside Job

APPRENTICES of the Bristol Aeroplane Co., Ltd., made all the metalwork (with the exception of the fan) for a new low-speed wind tunnel to be used at the company's Apprentices School. Since no carpentry is done at the school, manufacture of the wooden sections of the tunnel (which is 18ft long and of composite wood and metal construction) was entrusted to John Perkins and Son, Ltd.; but the total cost of the project, in which Bristol University has collaborated, is expected to be only about £1,000—compared with £2,500 or £3,000 if the equipment had been bought outside.

Lofty Theme

DISTINGUISHED American woman pilot Ruth Nichols, who is a lieutenant-colonel in the U.S. Civil Air Patrol, and who last January, in company with the commander of Suffolk Air Force Base, flew to a higher announced altitude than any other woman in the world (51,000ft), has recently published a book entitled *Wings for Life*.

H.P. Test Pilot

PHILIP MURPHY has joined the staff of Handley Page, Ltd., as an experimental test pilot. He qualified as an R.A.F. pilot in July 1947, and between 1948 and 1951 served with Nos. 56 and 66 fighter squadrons. During this period he led an aerobatic team and, in Meteors, took part in many flying demonstrations, including

Mr. Murphy.

the Festival of Britain Air Display at Hatfield in June 1951. Mr. Murphy resigned his commission in August 1951 in order to join Vickers-Armstrongs as an experimental test pilot and subsequently worked on the proving of missile systems on Washington, Canberra and Meteor aircraft. Later he was concerned with Valiant and Viscount development flying.

Milan Shop-window

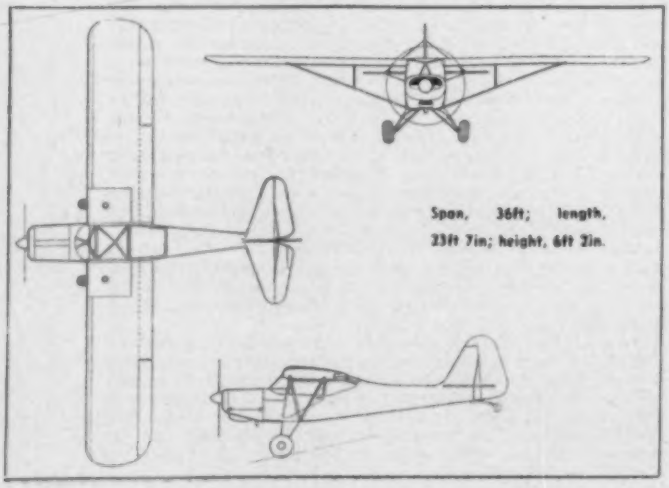
EXHIBITS on the Bristol Aeroplane Company's stand at the Milan International Samples Fair (which opens on April 12) are to include an Orpheus BOr.3 turbojet installed in the Fiat G.91; and scale models of the Britannia (in Northeast Airlines' livery), Bloodhound and the Type 192 helicopter.

Oil-bore Airlift

HELICOPTER transport for technicians, surveyors and equipment at the site of oil explorations at Giandari in West Pakistan is to be provided by a Westland Whirlwind of Fison-Airwork, Ltd., operating under contract to the Pakistan Shell Oil Co., Ltd. The aircraft, which is on its way out to Pakistan, will be based some 350 miles north of Karachi.

Sporting Number

A SPECIAL *Sports and Racing Cars* number is being published today (March 28) by our associated journal *The Autocar*. It includes expert appraisals and full performance data of the latest racing and sports models and is profusely illustrated with photographs and technical drawings.

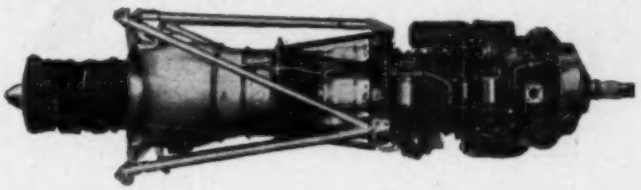


WORKMASTER: General arrangement of Auster's latest product, the agricultural and general-utility aircraft on which we published notes last week (p. 359). The engine is a Lycoming O-360-A of 180 h.p.

NAPIER ELAND TURBO-PROP ENGINES POWER THE FAIREY ROTODYNE

WORLD'S FIRST
VERTICAL TAKE-OFF
AIRLINER

A basic factor in the selection of these engines was their ability to provide power to the propellers for forward flight and compressed air to the rotor tip jet units for vertical flight.



NAPIER **Eland** *turbo-prop* D. NAPIER AND SON LIMITED, LONDON, W.3.

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Airliner Census

SPRING 1958

THIS, the first presentation of *Flight's* Airliner Census, aims at satisfying the needs of those who wish to know the latest disposition of airliners among the various regions and operators throughout the world. Combination of a fast-moving industry with frequently outdated records has set a challenge to the compiler seeking after absolute accuracy; and we hope that those who find this census useful will assist in making subsequent editions as up to date as possible.

At the head of page 414 is a description of the form of presentation. The main features of the census are discussed on page 415.

BOEING

B.307: No. built 10, in service 9.
B.377: No. built 57, in service 50.

North America	Latin America	Europe	Elsewhere
N'west (377) 9	AREA (307) 2	BOAC (377) 16	Air Laos (307) 2
PanAm (377) 25			Aigle Azur (307) 5

CANADAIR

DC-4M: No. built 53, in service 41.

North America	Latin America	Europe	Elsewhere
TCA 21		BOAC 17	EAAC 3

CONVAIR

CV-340: No. built 165, in service 139.

North America	Latin America	Europe	Elsewhere
American 63	A. Argentinas 4	Alitalia 4	Iran 2
Mohawk 11	Varig 5	Finnair 1	—
Northeast 6		KLM 5	Ethiopian 3
PanAm 1		Sabena 4	—
Western 9			Garuda 8
			Pakistan 4
			—
			Ansett 2
			TAA 2
CPAL 5			
95	9	14	21

CV-340: No. built 212, in service 191.

North America	Latin America	Europe	Elsewhere
Braniff 25	Aeronaves de Mexico 4	Alitalia 4	Saudi-Arab 10
Continental 6	Avensa 5	Finnair 3	—
Delta 18	Cruzeiro 4	JAT 1	Garuda 8
Hawaiian 5	LACSA 2	KLM 14	PAL 3
National 12	Real 6	Lufthansa 4	—
United 55			Ansett 2
121	21	26	23

CV-440: No. built 130, in service 129.

North America	Latin America	Europe	Elsewhere
Braniff 5	Avensa 1	Alitalia 2	All Nippon 3
Continental 3	Cruzeiro 4	Finnair 3	Garuda 3
Delta 8	Real 10	Iberia 5	—
Eastern 20		Lufthansa 5	Ansett 7
National 6		J.A.T. 2	
		Kar-air 2	
		Sabena 12	
		S.A.S. 16	
		Swissair 12	
42	15	59	13

CATALINA No. built 2,140, in service 41.

North America	Latin America	Europe	Elsewhere
Alaska Coast 1	Bahamas 1	Flugfelag 1	CAT 2
—	PAB 5	TAI 2	Foshing 1
CPAL 2	Transair Chile 3		UBA 1
N. Wings 2	TAM (Peru) 4		RAI 2
Pac. West 4			—
Quebecair 2			Qantas 2
Transair 4			
Wheeler 2			
17	13	3	8

CURTISS

C-46: No. built 3,141, in service 349.

North America	Latin America	Europe	Elsewhere
Aaxico 32	Air Chile 4	Olsen 3	El Al 6
ASA 6	ALA 4	Transair (Sweden) 3	Lebanese Internat. 2
Alaska 3	Austral		Air Jordan 1
All American* 4	Avensa 3		—
Argonaut* 4	Aviateca 2		Air Maroc 2
Associated* 2	Cubana 1		—
Cal. Haw.* 2	Cuba Postal 3		CAT 25
Capitol* 16	CDA 5		Foshing 1
Cordova 1	CINTA 2		Aigle Azur 1
Delta 5	COPA 2		
Flying Tiger 11	ENA 4		
Los Angeles* 1	Expresso 3		
Meteor* 2	LACSA 4		
Reeve 1	LANICA 2		
Regina* 4	LAV 4		
Riddle 34	Loide 26		
Seaboard 1	Nacional 5		
Slick 13	Q 4		
Southern* 2	RANSA 13		
Trans Carib.	Real 10		
Westair* 7	Sadia 2		
Wien 4	SAM 6		
World Wide* 3	SAP 2		
—	TAN (Honduras) 5		
CPAL 6	Transa Chile 3		
Mar. Central 3	T'Continental 3		
Pac. West 2	Varig 14		
Transair 2			
Wheeler 2			
173	132	6	38

de HAVILLAND (CANADA)

BEAVER, DHC-2 No. built 1,135, in service 69.

North America	Latin America	Europe	Elsewhere
TAG* 2	Aviance 11		CAAC 5
Wien 4	CDA 1		—
—	RANSA 2		Aigle Azur 2
Laurentian 6	TAM (Peru) 4		Air Laos 1
Mar. Central 1			Cambodge 1
N. Wings 4			de Kroonduif 4
Pac. West			Malayan 6
Sask. Govt. 4			—
Transair 3			Qantas 4
Wheeler 4			
28	18		23

OTTER, DHC-3 No. built 244, in service 23.

North America	Latin America	Europe	Elsewhere
TAG* 2		Wideroes 4	Air Laos 2
—			Aigle Azur 3
CPAL 2			All Nippon 1
Sask. Govt. 1			PAL 3
Wheeler 5			
10		4	9

DOUGLAS

DC-3, C-47: No. built 10,928, in service 1,642.

North America	Latin America	Europe	Elsewhere
Alaska 1	Argentinas 16	Aer Lingus 13	Aden 8
Allegheny 15	Aeronaves de Mexico 15	Air France 39	Air Jordan 3
Amer. Flyers* 4	Aeronorte 4	Alitalia 12	Air Liban 3
Blatz* 2	AREA 4	Braathens 2	Arab 3
Bonanza 9	AMSA (Mex.) 2	CSA 21	Arkia 3
Braniff 23	Aviateca 5	Finnair 9	Cyprus 4
Cal. Haw.* 2	Avianca 31	Flugfelag 3	Iranair 6
Cal. Central* 1	Avensa 18	Gibraltar 1	Kuwait 2
Capital 18	Brit. Guiana 3	Iberia 17	MEA 4
Caribbair 4	BWIA 3	JAT 13	S'Arab. 10
Central 13	CDA 2	Kar-Air 3	Syria 4
Continental 15	CINTA 2	KLM 14	THY 24
Cordova 2	COHATA	Linjeflyg 7	—
Delta 15	Cruzeiro 38	Lufthansa 3	Africair 3
Frontier 15	Cubana 6	Lufttransport 1	Air Algerie 3
General* 3	Faucett 9	Olympic 14	Air Maroc 3
Gt. Lakes* 3	LAB 10	Sabena 28	Air Madagascar 2
Hawaiian 8	LAC	SAS 10	CAAC 5
Johnson* 2	LACSA 3	Swissair 9	DETA 3
Lake Central 10	LADE	Transair (Swed.) 3	DTA 6
Mackey 2	LAN (Chile) 18	TAI 5	EAAC 9
Mantz* 1	LANICA 6	TAP 6	Ethiopian 8
Mohawk 11	LANSA 16	—	Liberian 2
N. Central 27	LAV 18	Air Kruise 6	SAA 6
Northeast 11	Mexicana 19	Airwork 3	Sudan 5
N. Consol 4	NAB	BEA 46	Tunis 3
N'West 5	PAB 14	BKS 5	WAAC 5
Ozark 20	PLUNA 6	Cambrian 2	—
Pac. North 4	Q 2	Dan-Air 2	Air Ceylon 2
Pac. (S'West) 15	RANSA 1	Hunting-Clan 5	Air India 1
Panagra 4	RAS 3	Manx 2	Air Laos 6
PanAm 2	Real 89	Scottish 1	Air Vietnam 7
Piedmont 21	Reforma 10	Skyways 3	Aigle Azur 5
Reeve 2	Sadia 3	Starways 4	All Nippon 9
Sourdough* 2	SAETA 5	Transair 10	Aryana 3
Southeast* 5	SAHSA 7		Cathay Pac. 2
Southern 13	SAM 3		CAT 5
Trans. Pac. 7	SAVAG		Cambodge 1
Trans. Texas 20	Teca Internat		COSARA 4
West Coast 14	Teca de Venez 13		de Kroonduif 3
Western 5	TAC		Foshing 2
Wien 3	TAI (Mex.) 2		Garuda 10
—	TAM (Peru) 8		IAC 65
CPAL 10	TAS		Kalinga 15
Marit. Central 8	T.M. de Cortes 3		Korea Nat. 3
N. Wings 2	Varig 23		Malaya 11
Quebecair 8	VASP 15		North Japan 1
Pac. West 7			PAL 29
Sask. Govt. 1			PIA 11
Transair 1			Thai 5
TCA 18			UBA 10
Wheeler 4			—
			Ansett 5
			ANA 14
			Butler 4
			East West 3
			Guinea 5
			MMA 5
			Mandated 5
			N.Z. Nat. 24
			Qantas 8
			Queensland 3
			TAA 20
422	455	322	443

Airliner Census . . .

Regional disposition of N. American and of European airliners is shown on pages 413 and 414, and on page 415 respectively. A break and short rule in each column denotes regional subdivisions: N. America into U.S. and Canada; Europe into the Continent and U.K.; Elsewhere into the Mid-East, Africa, Asia and Australasia. Airliners are shown alphabetically by names of manufacturers. The number built in some cases inevitably includes military production, but the number in service refers only to airlines. The number shown against each airline refers to the aircraft used rather than owned, the figures in parentheses referring to aircraft ordered but not yet delivered. Where a blank space is shown against an airline the precise number is unknown. Asterisks indicate that the carrier concerned is not certificated.

DOUGLAS, cont.

DC-4, C-54: No. built 1,163, in service 335.

North America		Latin America		Europe		Elsewhere	
Alaska	2	Argentinas	7	Air France	21	Air Liban	2
Capital	12	Aeronaves de Mexico	3	Braathens	2	Iranair	2
Central*	2	ATSA	1	Flugfelag	1	Leban. Internat.	(2)
Eastern	12	Avianca	12	Iberia	6	Saudi Arab.	4
Flying Tiger	6	Aviateca	1	Loftleidir	4	Syria	2
General*	1	CINTA	2	KLM	6		
Mackey*	2	COPA	1	Olympic	1	Air Algerie	6
Meteor*	2	ENA	2	Sabena	8	Air Maroc	4
N'West	15	Faucett	4	Sobelair	2	SAA	7
Overseas Nat.*	4	Guest	3	Swissair	3	Tunisair	2
Pac. North	2	LAB	2	TAI	2		
Panagra	2	LADE		TAP	3	Aryana	2
PanAm	25	LANICA	1	UAT	1	CAT	3
Reeve	1	Mexicana	6			Cathay Pac.	1
Regina*	1	RAS	3	Air Charter	3	Hong Kong	1
Resort*	8	Real	4	Independent	2	IAC	6
Riddle	2	Taca Internat.		Starways	1	JAL	9
Seaboard	4					Korea Nat.	1
Slick	6					TAIP	1
T'Carib.*						Thai	2
TWA	8						
United	2					ANA	8
U.S. O'Seas*	9					Qantas	5
Westair*	2					TAA	4
World*	4						
CPAL	1						
Mar. Central	4						
Quebecair	2						
Transair	1						
Wheeler	3						
	145		52		66		72 (2)

DC-6: No. in service 192.

North America		Latin America		Europe		Elsewhere	
American	50	Argentinas	6	Alitalia	3	Air Liban	2
Braniff	9	Mexicana	4	KLM	6		
Delta	7			Sabena	3	Cathay Pac.	1
Gt. Lakes*	4			SAS	12		
National	4			TAI	1	ANA	2
Panagra	5					TEAL	3
PanAm	28						
Trans. Carib.*							
United	42						
	149		10		25		8

DC-6A: No. in service 35.

North America		Latin America		Europe		Elsewhere	
Alaska	1			KLM	1		
American	10			Sabena	2		
Flying Tiger	2						
Overseas Nat.*	4						
Regina*	2						
Riddle	1						
Slick	7						
United	5						
CPAL	(4)						
	32 (4)				3		

DC-6B: No. in service 240 (22).

North America		Latin America		Europe		Elsewhere	
Alaska	2	LAN	3	Alitalia	8	Air Algerie	2
American	25	Loide	(4)	JAT	(2)	Ethiopian	(2)
Eastern	5			KLM	7		
Continental	5			Loftleidir	(2)	Cathay Pac.	(1)
National	8			Olympic		CAT	(1)
N'East	10			Sabena	8	JAL	7
N'West	17 (3)			SAS	14		
Panagra	5			Swissair	6	ANA	4
PanAm	30			TAI	4		
United	38 (3)			UAT	7 (2)		
Western	14						
CPAL	11						
Mar. Central	(2)						
	170 (8)		3 (4)		54 (6)		13 (4)

DC-7: No. in service 126 (13).
DC-7B: No. in service 56.
DC-7C: No. in service 117 (10).

North America		Latin America		Europe		Elsewhere	
American	58	Mexicana (C)	4	Alitalia (C)	6	SAA(B)	5
Braniff (C)	7	PAB (C)	4	KLM (C)	10 (1)		
Continental (B)	5	Real (C)	(3)	Sabena (C)	10	JAL (C)	4
Delta	17 (4)			SAS (C)	14		
Eastern (B)	28			Swissair (C)	5		
National	4			TAI (C)	3		
National (B)	4						
N'West (C)	8 (6)			BOAC (C)	10		
Panagra (B)	6						
PanAm (B)	8						
PanAm (C)	32						
United	47 (9)						
	224 (19)		8 (3)		58 (1)		9

GRUMMAN

VARIOUS FLYING BOATS (ALBATROSS, GOOSE, MALLARD, WIDGEON): No. in service 34.

North America		Latin America		Europe		Elsewhere	
Alaska Coast	9	Bahamas	2	Flugfelag	1	Guam	3
Cordova	1	Brit. Guiana	2				
Ellis	9	Seaward	1				
Mackey*	1						
Reeve	1						
BNP*	3						
Laurentian	1						
	25		5		1		3

LOCKHEED

L.18 and L.12: No. in service 44.

North America		Latin America		Europe		Elsewhere	
Byerley*	1	CINTA	2	Kar-Air	1	CAS (S. Africa)	3
National	10	LAN (Chile)	2	Linjeflyg	5	DETA	3
Pac. (S'West)	3			Wideroes	2		
Prov. Boston*	2					East/West	2
						MMA	1
Matane	4					South Coast	2
Transair	1						
	21		4		8		11

L.049: No. built 88, in service 58.

North America		Latin America		Europe		Elsewhere	
Capital	12	ALA (Chile)	1			El Al	5
Delta	4	Cubana	1				
TWA	32	SAP	3				
	48		5				5

L.749: No. built 133, in service 131.

North America		Latin America		Europe		Elsewhere	
Capital*	1	Aeronaves de Mexico	3	Air France	16	Air Algerie	2
Eastern	18	Avianca	1	KLM	10	Ethiopian	1
Pac. North	4	Guest	2			SAA	4
TWA	39	LAV	3	BOAC	16		
		PAB	11				
	62		20		42		7

L.1049 (incl. C.D.E.): No. built 102, in service 81.

North America		Latin America		Europe		Elsewhere	
Eastern	28	LAV	1	Air France	9	PIA	3
Seaboard	10			Iberia	3		
TWA	9			KLM	18		
	47		1		30		3

L.1049G: No. built 130, in service 126 (2).

North America		Latin America		Europe		Elsewhere	
Eastern	10	Avianca	4	Air France	14	Air India	10
TWA	28	Cubana	3	Iberia	5		
		LAV	4	KLM	8	Qantas	14
TCA	11	Varig	4 (2)	Lufthansa	8		
				TAP	3		
	49		15 (2)		38		24

L.1049H: No. built 29, in service 29 (12).

North America		Latin America		Europe		Elsewhere	
Dollar*	1	T'Continental	(5)	KLM	(3)	PIA	2
Flying Tiger	12	Real	(4)				
National	4					Qantas	2
Resort*	2						
TWA	4						
U.S. O'Seas*	2						
	25		(9)		(3)		4

L.1649A: No. built 43, in service 43.

North America		Latin America		Europe		Elsewhere	
TWA	29			Air France	10		
				Lufthansa	4		

MARTIN

4.202: No. built 43, in service 31.
M.404: No. built 103, in service 95.

North America		Latin America		Europe		Elsewhere	
Allegheny (202)	7	LAN (202)	4				
Eastern (404)	58	LAV (202)	2				
Pac. (S'West) (202)	7						
TWA (404)	37						
TWA (202)	11						
	120		6				

NORDUYN

NORSEMAN: No. in service 50.

North America		Latin America		Europe		Elsewhere	
Wien	5	Aviateca	1	Wideroes	6	PAL	4
						Thai	3
Pac. West							
Sask. Govt.	4					Gibbes Sepik	6
Transair	16						
Wheeler	5						
	30		1		6		13

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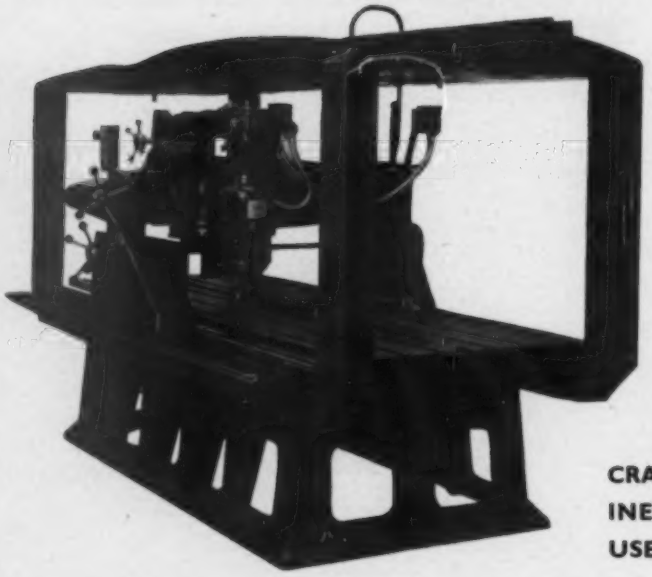

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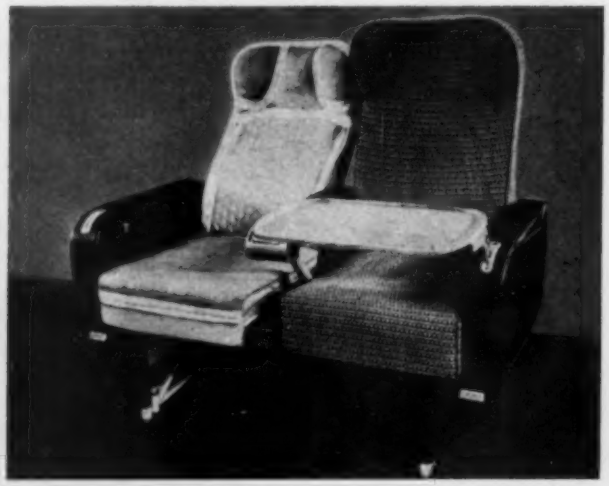

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FLIGHT Airliner Census . . .

There are today approximately 5,400 airliners in civil operation throughout the free world. North American manufacturers have contributed 4,500 to this total.

One out of every two airliners bears the name of Douglas: 2,750 of their aircraft are still in use, the ubiquitous DC-3 accounting for 1,650. Lockheed and Convair each account for approximately 500, while Vickers and de Havilland each have some 400.

A surprising feature of the airliner population is the number of elderly aircraft still providing regular and efficient service. After the DC-3, the C-46 Commando remains the second most important aircraft in terms of numbers in use. Equally remarkable is the existence in 1958 of nine of the ten Boeing 307s that were built almost twenty years ago. The presence of over 60 aged Lodestars, Electras and Ansons is further testimony to the longevity of a vehicle that airlines now claim to be obsolescent in four years.

The tables included in this census show only U.S., Canadian and British aircraft. The following list shows those airliners still in use that were produced by manufacturers elsewhere.

Bréguet Deux Ponts: Air France, 12; **Nord** Noratlas: U.A.T. 3; **Saab** Scandia: VASP, 17; **Sud-Est** Languedoc: Aviaco 5, Air Liban 1; Armagnac: SAGETA, 6; **Sud-Ouest** Bretagne: Air Algerie 2, Air Maroc 7, COSARA 4.

N. and S. America	Europe	Mid-east and Africa	Asia and Australasia
AIRSPEED (now de HAVILLAND)			
AMBASSADOR: No. built 21, in service 17.			
	BEA 12 BKS 2		Butler 3
	14		3
AVRO			
ANSON: No. built 11,020, in service 20.			
Wien 5 —			Flinders 2 MMA 3
N. Wing 1 Pac. West			South Coast 1 Woods 2
Wheeler 1 —			
AREA 5			
12			8
TUDOR: No. built 33, in service 8.			
	Air Charter 8		
YORK: No. built 256, in service 37.			
Maritime Cen. 1 Pac. West 2 Transair 1	Hunting-Clan 4 Scottish 3 Skyways 15	MEA 3 Persian Air 1 Trans-Med. 7	
4	22	11	
BRISTOL			
BRISTOL 170: No. built 214, in service 69.			
Transair 1	Aviaco 5 Iberia 4 Luft. Union 1 —	MEA 3 Saudi Arab. 5 —	Air Laos 2 Air Vietnam 4 Aigle Azur 2 —
	Air Charter 6 BEA 1 Channel 2 Jersey 1 Lancashire 2 Manx 2 Silver City 22	WAAC 2	ANA 3 SAFE 3
1	46	8	14
BRITANNIA 100: No. built 15, in service 15.			
BRITANNIA 300, 310: No. built 14, in service 14 (23).			
N'East (300) (5) —	BOAC (100) 15 BOAC (310)	El Al (310) 3	
CPAL (310) (6) Aeronaves	8 (10) Hunt-Clan (310)		BRISTOL
de Max. (300) 3 Cubana (310) (2)	(2)		
3 (13)	23 (12)	3	
HANDLEY PAGE			
MARATHON: No. built 40, in service 6.			
	Dutch? 1 Derby 1		All Nippon 2 UBA 2
	2		4
HERMES: No. built 25, in service 17.			
	Airwork 4 Britavia 4 Skyways 9		
	17		

N. and S. America	Europe	Mid-east and Africa	Asia and Australasia
de HAVILLAND			
RAPIDE: No. built 697, in service 94.			
SATGA TAM (Peru) 6	Air Couriers 2 Airviews 2 BEA 3 Cambrian 2 Channel 2 Derby 1 Don Everall 3 Jersey 2 Lancashire 1 Manx 1 Morton 1 Olley 3	Aden 1 Air Jordan 1 Arkia 1 Iranair 4 —	Malayan 3 —
		Africair 2 Air Algerie 3 Air Madagascar 4 Caspar 3 DETA 7 DTA 3 EAAC 4 Sierra Leone 3 STA (Angola) 3 S. W. Africa 1 TGA (Gabon) 2	Conellan 2 Fiji 1 Mandated 3 N.Z. National 6 Transpac 3 Trans-Island 1 TAA 3 West Coast 1
6	23	42	23
DOVE: No. built 500, in service 61.			
Catalina* 2 Gulf* 4 Illini* 3	SATA (Azores) 2 —	Gulf 4 Iranair 2 Iraqi 1 —	All Nippon 2 UBA 3 —
	Airviews 1 Cambrian 3 Channel 5 Morton 4 Olley 3	DETA 6 Sudan 6 WAAC 5	MMA 3 Southern 2
9	18	24	10
HERON: No. built 123, in service 84 (2).			
Gulf* 2 Illini* 1 —	Aviaco 2 Braathens 3 UAT 8	Gulf 3 THY 7 —	All Nippon 3 Garuda 14 IAC 8
Bahamas 3	Vestlandske 1 —	WAAC 8	TAIP (Goa) 2 —
	BEA 3 Cambrian 3 Jersey 7 Lancashire 1 (1) Manx 1 (1)		N.Z. National 4
6	29 (2)	18	31
SCOTTISH AVIATION			
TWIN PIONEER: No. built 13, in service 12 (5).			
	Scottish 3 Fison-Airwork 2	Brit. Internat. 2	de Kroonduif 3 Malayan 2 PAL (5)
	5	2	5 (5)
SHORTS			
SANDRINGHAM: No. built 33, in service 12.			
SOLENT: No. built 23, in service 6.			
HYTHE: No. built 6, in service 1.			
A. Argentin. (Sand.) 7 CAUSA (Sand.) 3	Aquila (Sol.) 4 Aquila (Hythe) 1	Shorts	Ansett (Sand.) 2 TEAL (Sol.) 2
10	5		4
VICKERS			
VIKING: No. built 160, in service 108.			
BWIA 1 LADE 15	Balair 1 Continental 2 Columbus 2 D. Flugdienst 4 Luft. Union 4 Transavia 5 —	Brit. Inter. 2 Iraqi 3 Misrair 6 —	IAC 12 TAIP (Goa) 2
	Airwork 5 Eagle 20 Hunting-Clan 9 Independent 7 Orion 1 Trade-Air 2	CAAC 2 Trekair 3	
16	62	16	14
VISCOUNT 700 series: No. built 241, in service 219 (32).			
Capital 59 —	Aer Lingus 4 Air France 11	Iraq 4 Iran (3)	Hong Kong 2 IAC 5 (5)
TCA 40 (11) —	Alitalia 6 (4) Austrian 4	MEA 7 Misrair 2 (2)	PAL 1 UBA 3
BWIA 8 Cubana 3	Flugfelag 2 —	THY 1 (4) —	Butler 2
LANICA 2 LAV 3 PLUNA 3 Taca Internat. 1	Airwork 2 BEA 25 Hunting-Clan 3	CAAC 5	TAA 11 (3)
119 (11)	57 (4)	19 (9)	24 (8)
VISCOUNT 800, 810: No. built 49, in service 47 (62).			
Continental (15) —	Aer Lingus 3 KLM 9	SAA (7)	PIA (3) —
Cubana (4) VASP (5)	Lufthansa (9) —		Ansett (4) N.Z. National 1 (2)
	BEA 30 (12) Eagle 2 Transair 2 (1)		
(24)	46 (22)	(7)	1 (9)

A Hastings of No. 41 Sqn., which operates from Changi, Singapore, and is one of three R.N.Z.A.F. transport squadrons.

Anniversary of a Commonwealth Air Force

R.N.Z.A.F. TWENTY-FIRST

TOMORROW (March 29) the Royal New Zealand Air Force is celebrating its 21st anniversary with a big display at Ohakea in which not only the R.N.Z.A.F. but also the R.A.F. and R.A.A.F. are taking part. It is right indeed that these sister air forces of the Commonwealth should be there, not only to pay tribute to the great Second World War effort of the R.N.Z.A.F. but because all have a common ancestor—the pre-war R.A.F.

It was in 1936 that W/C. (now Air Chief Marshal) the Hon. R. A. Cochrane went out to New Zealand at the Government's invitation to investigate and report on air force requirements and recommended that the R.N.Z.A.F. should be constituted as a separate service. This was implemented in the Air Force Act of 1937 and Air Chief Marshal Cochrane (who is due to be at the display) may well look round with satisfaction on the twenty-one years' growth; but the R.N.Z.A.F. had been an unconscionable time a'coming, and it was the looming war clouds which in the late 1930s hastened its formation.

The story of the R.N.Z.A.F. really started in 1923, when the N.Z. Permanent Air Force was first established by the Government as part of the military forces following pressure to that end by the Hon. (later Sir) Henry Wigram. He assisted in buying the first station—then called Sockburn and now named after him—and gave money to purchase aircraft and equipment. At that time the Air Force "strength" was four officers and three o.r.s; and there were 72 officers in the Territorial Air Force.

Progress for the next decade was slow; Wigram was enlarged and another station established near Auckland; but by March 1936 the permanent strength had reached only 20 officers and 107 airmen, plus a territorial strength of 74 officers.

W/C. Cochrane presented his report to the N.Z. Government in December 1936 and the Air Force Act establishing the R.N.Z.A.F. became law on April 1 the following year. At the same time W/C. Cochrane became its first C.A.S., with the rank of group captain, and the new Air Department was modelled on Air Ministry lines.

At once an expansion programme was put under way: an aircrew training school was established at Wigram; land was bought in the North Island to build two operational stations (Whenuapai and Ohakea); and thirty Vickers Wellingtons were ordered.

There were further expansion programmes in late 1937 and early 1938, including the establishment of a regular squadron at Blenheim and of three territorial flights. In March 1939 G/C. Cochrane, having seen the R.N.Z.A.F. well established, returned to U.K. and was succeeded by another R.A.F. officer, G/C. (now Air Chief Marshal Sir Hugh) H. W. L. Saunders.

When war came the expansion programme was far from complete but appreciable progress had been made. Strength was by then 91 officers and 665 airmen; and in the Territorial Air Force there were 79 officers and 325 airmen.

The thirty Wellingtons which were on order by the R.N.Z.A.F., and their aircrew who were to fly them out to New Zealand, were placed at the disposal of the R.A.F. and subsequently formed the nucleus of No. 75 (N.Z.) Sqn.—the first Commonwealth squadron to be formed in Bomber Command. This symbolizes not only the close link between the R.N.Z.A.F. and the R.A.F. but also the great contribution made by N.Z. aircrew to 1939-45 operations. Over 11,000 men from the Dominion served with the R.A.F., a quarter of them completely trained in New Zealand and the rest receiving initial training there before going to Canada. No fewer than 3,300 of those who served with the R.A.F. lost their lives, and 580 were taken prisoner.

In New Zealand during the war the R.N.Z.A.F. reached its peak strength of 30,500 plus a further 6,000 in the Pacific. There were 36 main establishments in the country, numerous locations in the Pacific area, and 25 squadrons to cope with Pacific commitments.

After the war the R.N.Z.A.F. faced first a period of rapid demobilization and then one of uncertainty, until in 1947 a permanent post-war establishment was approved.

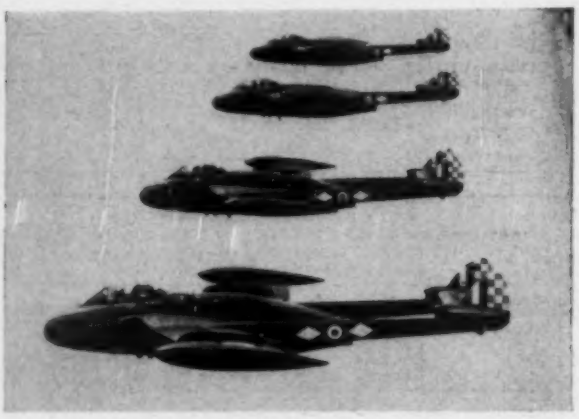
Regular recruiting and training for both ground tradesmen and aircrew recommenced and a re-equipment programme was instituted to bring the Service more up to date. New Zealand accepted its part in Commonwealth defence and in 1952 a fighter squadron was sent to Cyprus to operate with the R.A.F. Later it was transferred to Singapore and there, with a transport squadron, forms the R.N.Z.A.F. element in F.E.A.F.

Today the R.N.Z.A.F., with a regular strength of 5,000 (the Territorial Air Force was disbanded in June last year, with as many enthusiastic expressions of regret and disapproval as marked the passing of the R.Aux.A.F.) and the aim is to have "a small but highly trained and efficient force." Its Vampires are being replaced with English Electric Canberras and crews are training in the U.K.; and close associations are being maintained with the R.A.F., typified by the training of some cadet officers and apprentices. When the Queen Mother presented No. 75 Sqn. with its standard at Palmerston North last month the standard bearer was a young R.N.Z.A.F. P/O. named Enright. Last year, having completed his course at Cranwell, Sen. U/Off. T. E. Enright swept the board for honours—winning the Sword of Honour, the Queen's Medal and the R. M. Groves Memorial Prize.

He is one of the officers who will help to shape the R.N.Z.A.F.'s future; and having looked briefly at its past, recalling its magnificent contribution to Allied wartime operations, we salute the R.N.Z.A.F. on its 21st anniversary and wish it continued success.

At right, a Sunderland of No. 5 Sqn., which not only carries out M.R. duties but is frequently employed on "mercy missions"—such as bringing medical aid to isolated Pacific islands.

Far right, Venoms of No. 14 Sqn., which is now being re-equipped with Canberras and will be based in Malaya as part of the R.N.Z.A.F. contribution to F.E.A.F. and SEATO.



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Flight-refuelling the Valiant

IT is now permissible to describe and illustrate the probe-and-drogue flight-refuelling technique as applied to the Valiant by Vickers-Armstrongs (Aircraft), Ltd., working to M.o.S. contract in conjunction with Flight Refuelling, Ltd., the originators and manufacturers of the equipment.

All Valiants in service with the Royal Air Force can be modified to supply or receive fuel in flight; a large number of the production aircraft were in fact completed with the basic fittings for the tanker or receiver rôles and may be converted to tankers on the squadrons in a matter of hours. The receiver conversion, which involves only the fitting of a probe, can be made within minutes. Conversion of a Valiant to a tanker consists principally of the installation of a bomb-bay fuel tank, with turbine pump and piping; fitment of turbine pumps in the fuselage tank cells; installation in the bomb bay of the hose-drum unit, piping and fuel pump; addition of a bomb-bay fairing, wing stalks and underwing tanks; and the installation of the fuel transfer control panel in the cockpit.

The use of Valiant tankers significantly improves the scope of flight refuelling as contacts may be made at high altitudes and speeds (in the past, with piston-engined tankers, the jet receiver aircraft was compelled to reduce operating height and speed). Transfer rate is high, the tanker's equipment being designed to meet the normal pressure refuelling requirements for military aircraft.

At the start of the operation the tanker trails the refuelling hose to its full length of some 90ft. To resist the air loads on the drogue an electric motor is geared to the hose drum via a fluid coupling and tends to wind the hose back on to the drum. The drogue, however, gives a set load for a given airspeed. This load is in excess of the "wind-in" load of the hose unit, and consequently the hose trails to its full length. If the drag is reduced, the motor winds in the hose on the drum and any slack is taken up.

The receiver Valiant flies the probe into the drogue at a relative speed of three to four knots and proceeds to close on the tanker. Surplus hose is then being wound back on to the drum. When the receiver is in the refuelling position, as indicated on the tanker control-panel, the tanker operator switches on the fuel valve. Provision is made for de-icing the probe before contact and for earthing any difference of electrical potential between the two aircraft.

After completion of refuelling the receiver aircraft falls back to full hose extension. At this point the load on three spring-loaded toggle arms, which had closed on to the refuelling probe on contact, increases until the break-away load is reached. The refuelling cycle is then complete.

In developing the system Vickers-Armstrongs and Flight Refuelling faced several new problems. For fuel booster pumping air turbines were chosen, using engine air. Tappings from each Avon were already connected with a common feed for pressurization and de-icing, and this was now extended to fuel transfer. Booster-pump flow-rate is suited to the individual capacity of the tanks to ensure reasonably simultaneous emptying.

The technique for hose trailing took some time to perfect. Initially it was decided to open the bomb doors on the tanker and trail the hose. This at first proved unsuccessful, owing to buffeting and vibration of the hose-drum unit. When this trouble had been cured a trials receiver aircraft was brought in close to the trailed hose. Turbulence over the receiver aircraft from the open bomb bay of the tanker was severe, and a bomb-bay fairing had to be evolved.

A great deal of development was required to establish the length of probe and type of drogue, for turbulent air behind the drogue caused vibration problems on the receiver, and difficulty in making contact at the required airspeeds was encountered. Solid and perforated drogue cones of various angles were tried. Some models were tunnel-tested, using fuel as the medium, to study flow patterns. The final drogue configuration is a generously slotted cone.

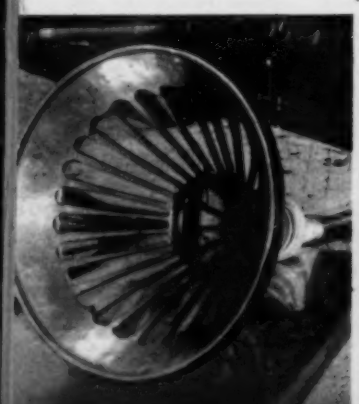
The success of in-flight refuelling of Valiants today is due in large measure to the far-sightedness of Sir Alan Cobham in founding Flight Refuelling, Ltd., in 1934. The "looped hose" system of air refuelling was developed by his company and much exploratory work was done before the war. After the war the U.S.A.F. evaluated the system with tanker B-29s refuelling B-29 bombers.

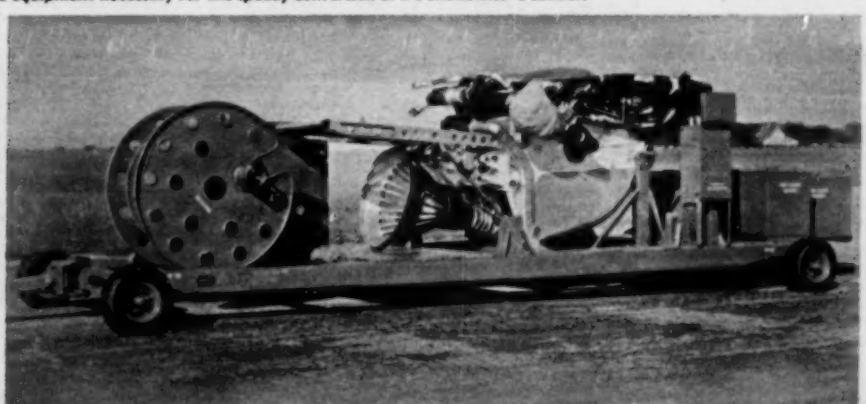
It was not until the advent of the turbojet engine that the probe-and-drogue method was devised by Flight Refuelling. First trials were carried out with a Meteor refuelling from a converted Lancaster tanker in 1949.

With the advent of the Korean war the U.S.A.F. adopted the F.R. probe-and-drogue system to increase the range and endurance of their Japan-based fighter aircraft. The United States Navy are currently using the British-designed equipment to increase the range of their strike aircraft.

The equipment used on the Valiant stems back to work carried out from 1951 onwards with Lincolns and Canberras as tankers, and Meteors and Canberras as receivers.

(Left) The reception coupling and drogue, which are illuminated for night contacts. (Right) Mk 16 hose-drum unit on its servicing trolley, which carries all necessary test equipment. The unit forms a "package," and the trolley also has a set of pump "packages," so that it carries all the equipment necessary for the speedy conversion of a Valiant into a tanker.





MISSILES

JUPITER C VANGUARD ATLAS THOR

DRAWN to a scale of ten feet to an inch, the big rockets of the American arsenal can be compared with the "V-2" on the far right and the Spitfire. The ICBM is, of course, larger than the satellite launchers, owing to its far greater payload; but the nuclear-tipped Sergeant can accomplish all that could be done by the big V-2 of 15 years earlier.

JUPITER C satellite launching vehicle, developed for the U.S. Army by Redstone Arsenal, Bell Telephone Laboratories and other agencies; built by Chrysler in Detroit. Example shown is that which placed a satellite in orbit (1st January 31). First stage is a modified Redstone with increased fuel capacity and high-energy fuel. This carries a cylindrical frame containing 11 solid-fuel Sergeant motors, which in turn boosts the third stage with four solid Sergeant motors. The final stage is a cylindrical satellite mounted on a single solid Sergeant.

Overall length, approximately 60ft; body diameter, 90in; launching weight, 64,000 lb; propulsion (first-stage), R.A.A. Rocketdyne four-chamber motor rated at 84,000 lb.

VANGUARD satellite launching vehicle, developed for the U.S. Navy with The Martin Company (Baltimore) as system manager. Example shown was destroyed on its launching pad on December 6; the fourth Vanguard successfully placed a small satellite in orbit on March 17. The vehicle is unique and has a high firepower ratio. The first stage comprises tankage for liquid oxygen and petrol feeding a General Electric gimbal-chamber motor rated at 27,000 lb. The second stage) employs an Aerojet-General gimbal-chamber motor rated at 7,500 lb running on nitric acid and hydrazine (RFNA and UDMH). The final stage) has a solid-propellant motor by the United Control Rocket Company, rated at 1,300 lb.

Overall length, 72ft; body diameter (first-stage), 45in; launching weight, 25,000 lb.

ATLAS intercontinental ballistic missile, developed for the U.S.Air Force as Weapon System 107-A-1, the missile itself being SM-65A. Prime contractor is Convair Astronautics Division; guidance is effected by very powerful radar (G.E.) and inertial (Arma) systems involving a Burroughs computer, and contractor for propulsion is R.A.A. Rocketdyne Division. There are three gimbal-chamber motors, all fed with liquid oxygen and kerosene and all ignited on the ground. The two 150,000-lb based motors are jettisoned at burn-out, leaving the single 135,000-lb sustainer, plus two vernier engines for final trajectory corrections.

Overall length, 75ft; base: body diameter (excluding guidance package), 120in; launching weight, reported to be 260,000 lb; design range, up to 6,300 miles; peak Mach number, about 20.

THOR intermediate-range ballistic missile, developed for the U.S. Air Force as Weapon System 315A, the missile itself being SM-75. Prime contractor is Douglas Aircraft; guidance is effected by a truly inertial system managed by A.C. Spark Plug division of General Motors, and propulsion is provided by a single gimbal-chamber motor by R.A.A. Rocketdyne Division, rated at 150,000/165,000 lb. Two vernier motors provide final trajectory control. The example shown has the satellite nose-cone and re-entry body (by G.E.) which will probably be fitted to Atlas also.

Overall length, 65ft; maximum diameter, excluding fairings, 8ft; launching weight, reported to be 110,000 lb; design range (present SM-75), 1,500 miles; peak Mach number, about 15.

TO SCALE

To the same scale: the Supermarine Spitfire VB

JUPITER **REDSTONE** **SERGEANT** **CORPORAL** **A.4 (V-2)**

JUPITER Intermediate-range ballistic missile, developed for U.S. Army Ordnance and operationally assigned to the U.S. Air Force. Those chiefly responsible for the design were Redstone Arsenal (manager), Gulfstab J.P.L. and Chrysler, the latter being prime contractor for manufacture. Guidance is effected by a fully inertial system managed by the Ford Instrument division of Sperry-Rand; Jupiter is propelled by the same gimbal-chamber Rocketdyne motor of 150,000/165,000 lb thrust which powers Thor, but has only a single vernier motor and so is oriented to azimuth before launching. Production rounds may have a different nose cone.

Overall length, 58ft; body diameter, 10ft 3½in; launching weight, reported to be 160,000 lb; design range (first production type), 1,500 miles; peak Mach number, about 12.

REDSTONE Tactical ballistic missile, developed for U.S. Army Ordnance as SSM-A-14 (XSS). Design was handled by Redstone Arsenal, assisted by Gulfstab J.P.L., and Chrysler are mass-producing Redstones at Detroit. Guidance is effected by an inertial system managed by the Ford Instrument Division of Sperry-Rand, which pivots aerodynamic controls, vanes sheltered within the motor and final control surfaces mounted on the separable fore-body. Propulsion is provided by a fixed-chamber R.A.A. Rocketdyne motor rated at 75,000 lb.

Overall length, 69ft (also reported as 62ft and 63ft); body diameter (over fairings), 90½in; launching weight, approximately 65,000 lb; design range, approximately 200 miles; peak Mach number, approximately 5.

SERGEANT Tactical ballistic missile, developed for U.S. Army Ordnance by Sperry-Rand Corporation and Gulfstab J.P.L. and now coming into production at the Utah Engineering Laboratory, Salt Lake City, of the Sperry-Rand Corporation. The warhead is lighter and smaller than that of Corporal, although the yield can be similar; guidance is effected by a self-contained inertial system and propulsion takes the form of a Thiokol solid-charge motor rated at some 50,000 lb. Aerodynamic and jet-deflection vanes are provided.

Overall length, approximately 36ft; diameter, 31in; launching weight, about 12,000 lb; design range, from 65 to 170 miles according to warhead; peak Mach number, about 5.

CORPORAL Tactical ballistic missile, developed for U.S. Army Ordnance chiefly by Gulfstab J.P.L. and manufactured by Firestone. Guidance is effected by a radar command system produced by GM/Haz and Motorola, which collates aerodynamic and jet-deflection vanes; the motor is a fixed-chamber Ryan unit rated at 20,000 lb and running on RFNA and xylidine. The warhead can be an H.E. charge, or nuclear devices rated at 10, 20, 50 or 100 kilotons. Designated M45E-1 by the U.S. Army and Corporal Mk 1 by the British Army, the weapon is regarded as obsolescent.

Overall length, 46ft; body diameter, 30in; launching weight, approximately 20,000 lb; design range, 100 miles; peak Mach number, 3.5.

A.4 (V-2) Tactical ballistic missile, developed between 1939 and 1944 for the German Army by the Army Experimental Station at Peenemünde. Propulsion was effected by a fixed-chamber motor rated at 56,000 lb, and guidance comprised an autopilot and a radio-doppler system which later gave way to a system of integrating accelerometers, control being effected by aerodynamic rudders and jet-deflecting vanes. The usual warhead contained 1,654 lb of amatol.

Overall length, 46ft 11in; body diameter, 65½in; launching weight (typical), 28,200 lb; design range, 220 miles; peak Mach number, 4.4.

"FLIGHT" COPYRIGHT DRAWINGS BY D. I. PUNNETT

COMET RESURGENT

"Flight" photograph

A DECADE OF D.H. JET TRANSPORT DESIGN

THAT the Comet is "the most structurally tested aeroplane built to date" is a claim unlikely to be challenged. The de Havilland Comet 1, when it went into service in 1952, possessed a structure which could itself fairly claim to have undergone static tests at least as comprehensive as any to that date. Subsequent events, which exposed so publicly the wide gaps in man's knowledge of metal-fatigue, have now passed into the perspective of history. But the completely redesigned Comet structure which has since emerged probably represents—as it should—the contemporary art of structural design at its best.

The rig-testing programme behind the Comet 4 has been in progress without interruption since the start of the Comet 1 investigation in the early summer of 1954. The programme has been in two parts: (1) basic research into materials and design-methods to establish a new anti-fatigue design formula, (2) applied research to test actual detail Comet 4 components designed according to these new principles.

All this work, with one important exception, is now complete —at least so far as the Comet 4 is concerned, though obviously general basic research into fatigue goes on. The exception is the final proof-of-the-pudding test of a complete Comet 4 wing and fuselage. This assembly is now being immersed in the D.H. water tank at Hatfield where, during the next six months, it will be subjected to the now familiar programme of tank tests (*Flight*, December 30, 1955). A photograph appears on page 424.

It may be asked why, after such a comprehensive programme of demonstrating the safe life of the detail ingredients of the Comet 4 structure, an expensive verification test such as this is necessary. Scientifically, the results of satisfactory component-testing—which embraced seams, joints, materials, windows, canopies, centre sections, spars, undercarriage, etc.—might be proof enough. The fact that the complete test is nevertheless being made is a testimony to the thoroughness of the whole approach to Comet testing, as exhibited by D.H., the Air Registration Board and—not least important, since they have borne the greater burden of the cost —the Ministry of Supply.

The aim throughout the structural design and test-programme has been a minimum safe life for the Comet 4 higher than its useful operational life. If one assumes for "useful operational life" a figure of not less than 30,000 hr the magnitude of the test-programme can be appreciated. To provide for the scatter characteristics of fatigue, each specimen component has been tested to a figure five to six times in excess of this life (factors of 6 for the pressure cabin and 5 for the wing have in fact been applied).

An unexpected consideration in the early days of the Comet 4 design was the more severe fatigue-case presented by the (at that stage unforeseen) Comet 4B. This shorter-range member of the family—developed only during 1957 for B.E.A.—will obviously spend much more of its "useful operational life" riding gusts, pressurizing its cabin, landing, and so on. But D.H. are confident that the basic test-programme has been comprehensive enough to ensure that the 4B will be as good for 30,000 hr as the Comet 4.

A point worth noting particularly is that the fatigue-proofing process has been applied not just to the structure—i.e., to the parts of the aeroplane subject to flight loads. It has, in the words of a senior D.H. designer, been extended to "everything in the aeroplane that gets a towsing"; in order words, to a hundred-and-one components in the power systems and ancillary equipment.

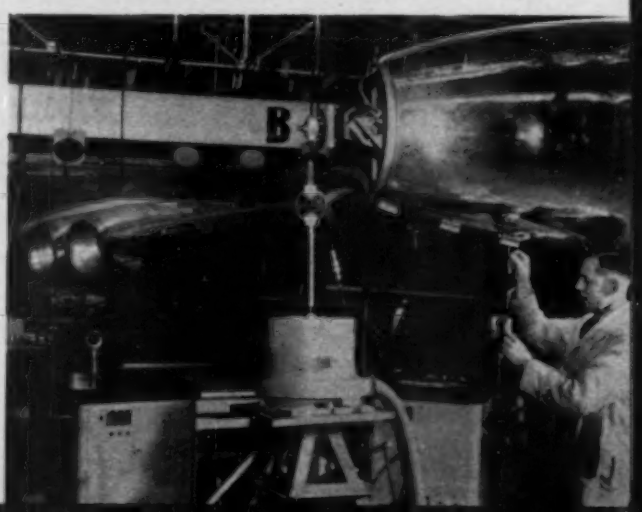
On the controversial structural question of "safe life" *versus* "fail-safe," the D.H. principle seems to be that there is no clear-cut distinction between either philosophy. If it is possible to design components to fail-safe, then this should obviously be done; but whether a component is fail-safe or not, it must certainly be designed for, and demonstrated to possess, a safe life.

General Comet 4 structural details worth highlighting are extensive modification of the rear fuselage to withstand jet-blast (the inner pipes of the 4, like those of the 2, are of course canted outwards to minimize the effect of blast experienced on the Comet 1s); redesign of the tailplane and elevators with thicker skins and doubled-up ribs to deal with the fatigue effects of jet noise; the use of 24ST (naturally aged aluminium alloy to American specification) on the lower tension surface of the wings; exclusion of zinc-alloy skins from the fuselage; and the use of steel for the important lug-forgings as employed for the attachment of wings, tailplane, and so on.

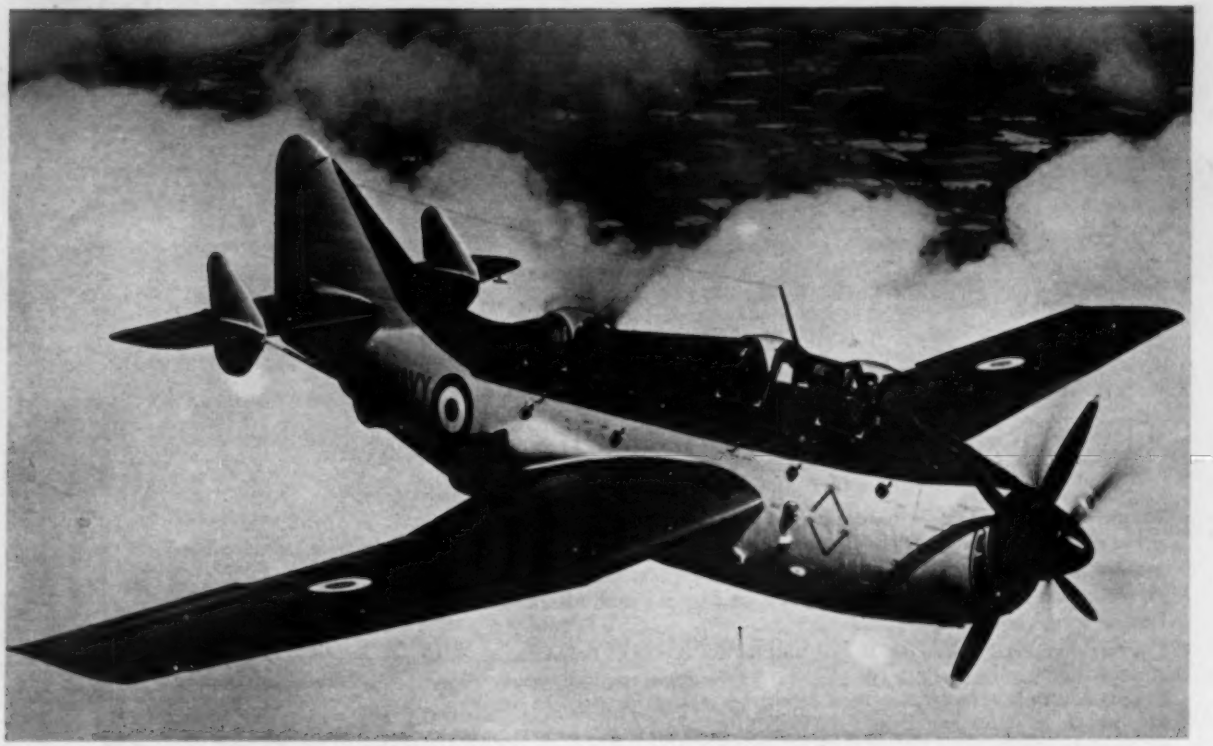
Structurally, therefore, the Comet 4 is a completely new design, to the extent that those familiar with the Comet 1 can examine almost any detail of the new Comet and find that it is different. All that remains the same, allowing for the different proportions, is the external shape.

Re-engineering of the Systems. As was the case with the structure, each system in the Comet 4 was completely reassessed and in certain instances (e.g., electrics, cabin-air-system control, and flying controls) modified to embody features suggested by operational experience and modern ideas. A good new idea, for example, is the complete separation of all components associated with, respectively, the electrical and hydraulic systems.

In accordance with modern practice, the electrical power



The first production Comet 4, structurally quite different from previous Comets, undergoes a resonance test at Hatfield. Flight tests will begin next month, and deliveries to B.O.A.C. will start in September.



One GANNET is a team

The hunter-killer team, consisting of two aircraft, one searching and the other striking, passed into history when the Fairey Gannet joined Squadrons of the Royal Navy.

Each single Gannet can carry out an anti-submarine operation unaided, hunting down the underwater raider with search radar and striking it with homing torpedoes, depth charges, mines and rockets.

The range and endurance required of a sub-hunting aircraft are provided by the Armstrong-Siddeley Double Mamba, a propeller-turbine that consists of two engines in one installation. One half of the engine is shut down for maximum economical cruising. Two engines, developing a total of over 3,000 e.s.h.p., are available for attack and provide the twin engine safety that is a prerequisite for ocean patrols.

Already serving with the Royal Navy and the Royal Australian Navy, the Gannet is on order for Western Germany's Naval Air Arm.

FAIREY GANNET

Shore-based or carrier-borne
the Fairey Gannet is the most sophisticated concept
of an anti-submarine aircraft in the world

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The passenger will decide

The passenger will choose the jet

The entirely new standards of speed and comfort make jet travel irresistible. The airline which operates jets will have the prestige, the passenger appeal, the revenue.

The new Comet is the only jet airliner in the world which is backed by a wealth of experience and development. Its Rolls-Royce Avon engines already have a million hours of service behind them.

The Intercontinental version will be operating on the services of British Overseas Airways Corporation by 1959. It will carry its capacity payload, about 60 passengers with first-class seating or, if desired, up to 76 passengers with tourist-class seating, on stages up to about 3,000 miles.

The Continental version will be operating on the services of British European Airways Corporation by 1960. This version will carry its capacity payload, about 84 first-class passengers or up to 99 tourist-class passengers, on stages as short as 300-500 miles, and up to about 2,000 miles.

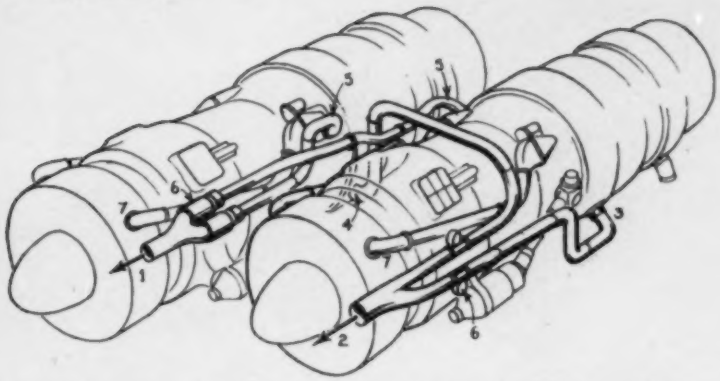
Both versions of the new Comet are specifically designed and developed to operate and pay their way on routes of moderate traffic density and from airports of moderate size.

The New COMET

(Four Rolls-Royce Avon jet engines)

Master of the routes of moderate traffic density — from 1959

D E H A V I L L A N D



Four Rolls-Royce Avon RA.29s, rated at 10,500 lb thrust each, power the Comet 4. (Left) Test installation of the thrust-reverser in the Comet 3, for later incorporation in production 4s. (Above) How the RA.29 supplies not only the Comet's propulsion needs: 1, cabin air delivery; 2, anti-icing air delivery; 3, anti-icing air tapping (outer engines); 4, anti-icing air tapping (inner engines); 5, cabin air tapping; 6, control valves; 7, engine anti-icing air.

COMET RESURGENT . . .

distribution was duplicated by means of a split busbar, which, with a separate emergency busbar, provides for every contingency of electrical power failure. Capacity of the alternators is now 350 amps compared with 250 on the Comet 1, and all the electrical equipment has been thoroughly explosion-tested. American inverters are fitted (by Jack and Heintz) and American-type terminals are used; multi-pin plugs have been eliminated wherever possible.

The biggest change in the flying-control system is the introduction of artificial feel proportional to q, the parameter which determines air-loads according to the V^2 law. Q-feel is fully applied to the elevators, and the same system is used to restrict rudder-movement above 180 kt. No q-feel is applied to the ailerons, which cannot break the aeroplane. (Rudder movement by itself cannot in fact do so, but abuse of the rudder above 180 kt could conceivably cause excessive yaw and overcontrol; it thus requires restriction.)

The q-feel system is of D.H. design, and the external q-sensitive device (see cut-away drawing, pages 422-423) is remarkably neat and small. The compact dimensions have been achieved by using the effect of suction as well as of pitot-pressure to move—*à la* pneumatic jack—the operating piston. Though the flying-control system is still fully power-operated, Comet 4 pilots will have feel proportional to airspeed, as in natural-feel manual control systems.

Besides the inclusion of q-feel, numerous other changes have been introduced in the flying-control system. The Comet 1 was criticized for its high break-out force—the force required to displace the control column; in the Comet 4 this has been reduced from 18 lb-20 lb to 10 lb, mainly by the elimination of friction from the control system, and by the addition of automatic cable-tension compensators.

Another important addition is automatic trim with the autopilot (Smiths S.E.P.2) in use. Comet 1 pilots found it a nuisance to have to keep an eye on the trim indicator and to have to wind-on trim manually to compensate for the trim displacement of the autopilot. If they did not wind-on trim the autopilot's limit-switch could cut out, perhaps leaving the aeroplane considerably out of trim. The new system ensures that the autopilot trim position has been automatically compensated for. This compensation is achieved by an electric motor, in the pilot's trim circuit, which is sensitive to changes of load in the autopilot.

Stall-warning is provided artificially by means of a stick-shaker. The old Comet 1 gave warning of the stall by airframe shake—as indeed will the Comet 4. But because the stall can be fairly well advanced by the time the airframe starts to shake it was judged prudent to incorporate a stick-shaker. This installation was perfected on the Comet 2, and on the Comet 4 is arranged to operate at a speed 12 per cent above the stall whatever the aerodynamic configuration of the aircraft. Of course, a stalling situation is never likely to arise in service, and Comet 4 pilots can expect to experience stick-shake only during training and checks.

Again as in the Comet 2, gearing has been introduced into the elevator system so that the ratio of elevator displacement to stick movement is higher (2 : 1) during take-off and landing than during flight. Take-off is made with the elevator coarse; this is changed to fine during the climb to make the elevator less sensitive to stick movement. There is, in addition, a Mach-sensitive device in the elevator circuit (as developed for the French and Canadian Comet 1As) which automatically applies up-elevator at Mach 0.77. The Comet 3 has, incidentally, been tested up to a true Mach of 0.835.

Numerous refinements have been introduced into the flying controls. Requirements called for ability to trim the aircraft should the main controls fail: as the Comet achieves its trim by means of the main surfaces, special measures had to be taken. The solution is that the elevator has a duplicated power input and output—i.e., it has separate power boosters each with its separate control cable from the stick. Likewise the aileron power boosters have duplicated input and independent output, and the rudder is duplicated inasmuch as it has an independent trim circuit. The flying-control hydraulics, as before, are served by three systems, but these are now completely separate. The "yellow" emergency system, again as before, is supplied by an electrically driven pump, but one that is now cleared for continuous running if necessary.

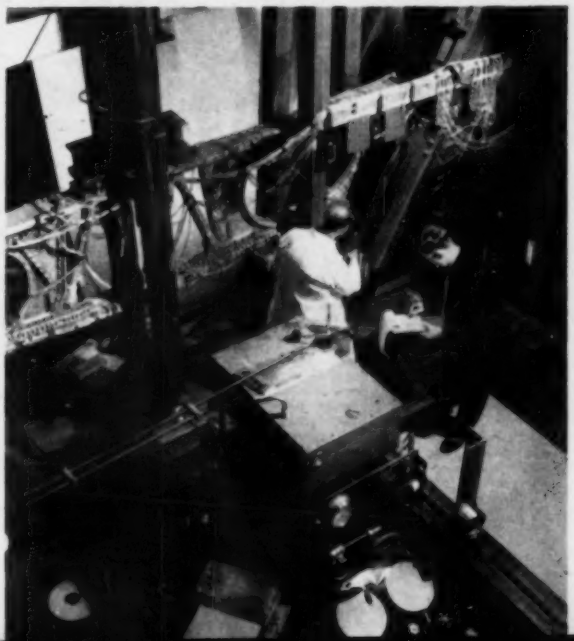
Other control improvements are more powerful ailerons (increased chord), and more drag for landing. The flaps are of the same general design, but movements have been changed so that "over the hedge" the inner split flaps move down from 60 deg to 80 deg. The outer plain-flap settings remain at 40 deg. A yaw-damper (autostabilizer) is fitted in the rudder circuit, and an automatic approach (I.L.S.) coupler is included in the autopilot system.

The Comet 4 (together with the Caravelle, whose control system conforms closely to that of the Comet) will be unique among transports in having power-operated flying controls, a legacy of the early days of Comet design when insufficient was known about the manual control problems of large, high-speed aircraft. But it is fair to add that no other transport will have flying controls which have been more thoroughly tested, or provided with more safeguards.

Another Comet 4 system which has been quite radically changed is that concerned with air-conditioning and pressurization. The

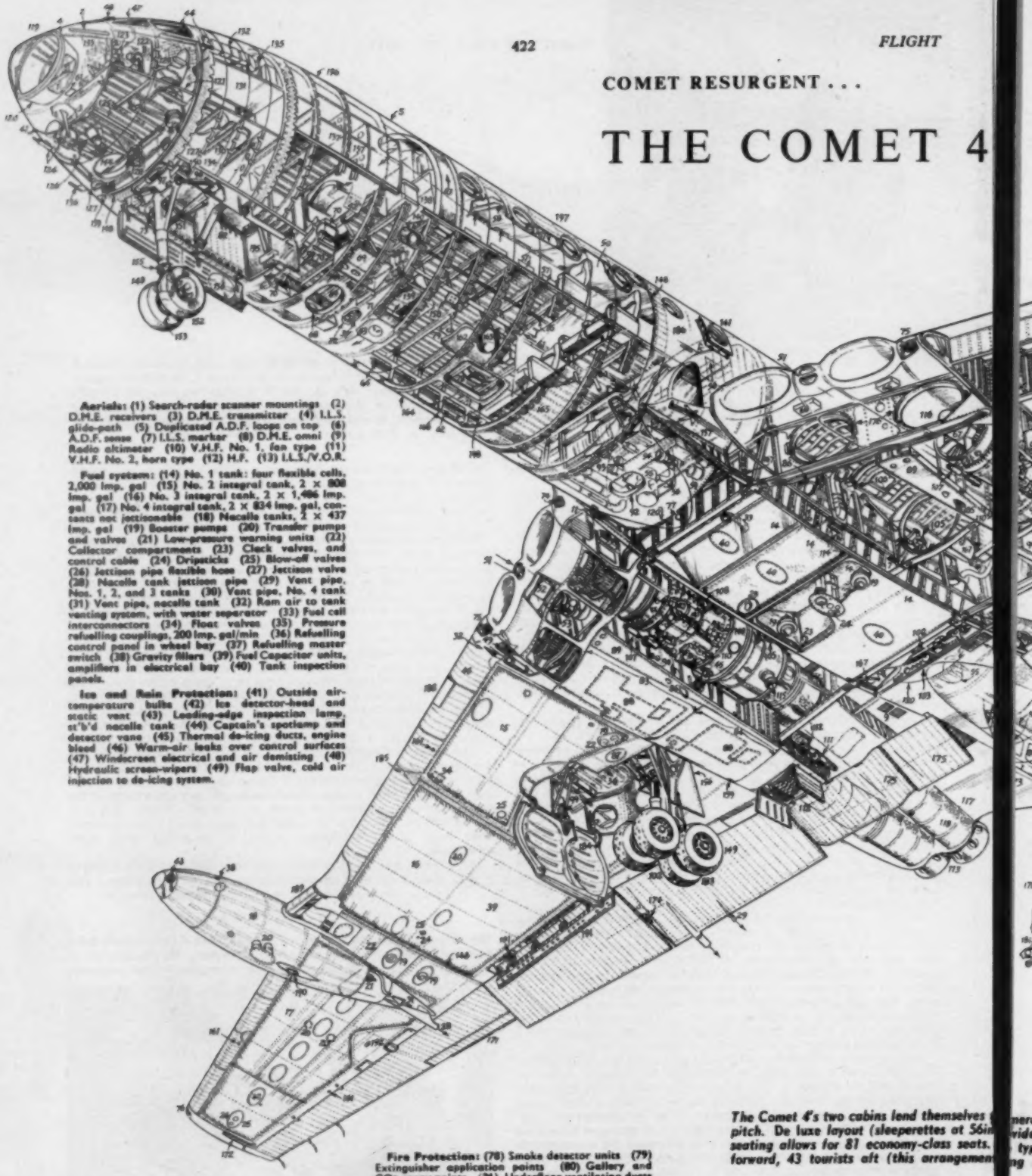
(*Continued on page 424, after double-page drawing of Comet 4*)

The structural-test programme behind the Comet 4 has probably been on a scale unprecedented in aircraft design history. Here is seen one of hundreds of tests: a strain-gauged spar undergoes fatigue reversals.



COMET RESURGENT . . .

THE COMET 4



Aerials: (1) Search-radar scanner mountings (2) D.M.E. receivers (3) D.M.E. transmitter (4) I.L.S. glide-path (5) Duplicated A.D.F. loops on top (6) A.D.F. sense (7) I.L.S. marker (8) D.M.E. omni (9) Radio altimeter (10) V.H.F. No. 1, fan type (11) V.H.F. No. 2, horn type (12) H.F. (13) I.L.S./V.O.R.

Fuel system: (14) No. 1 tank: four flexible cells, 2,000 Imp. gal (15) No. 2 integral tank, 2 × 908 Imp. gal (16) No. 3 integral tank, 2 × 1,486 Imp. gal (17) No. 4 integral tank, 2 × 834 Imp. gal, constants not jettisonable (18) Nacelle tanks, 2 × 437 Imp. gal (19) Booster pumps (20) Transfer pumps and valves (21) Low-pressure warning units (22) Collector compartments (23) Check valves, and control cable (24) Dripsticks (25) Blow-off valves (26) Jettison pipe flexible hose (27) Jettison valve (28) Nacelle tank jettison pipe (29) Vent pipe, Nos. 1, 2, and 3 tanks (30) Vent pipe, No. 4 tank (31) Vent pipe, nacelle tank (32) Ram air to tank venting system, with water separator (33) Fuel cell interconnectors (34) Float valves (35) Pressure refuelling couplings, 200 Imp. gal/min (36) Refuelling control panel in wheel bay (37) Refuelling master switch (38) Gravity fillers (39) Fuel Capacitor units, amplifiers in electrical bay (40) Tank inspection panels.

Ice and Rain Protection: (41) Outside air-temperature bulbs (42) Ice detector-head and static vent (43) Leading-edge inspection lamp, st'b'd nacelle tank (44) Captain's spotlamp and detector vane (45) Thermal de-icing ducts, engine bleed (46) Warm-air leaks over control surfaces (47) Windscreen electrical and air demisting (48) Hydraulic screen-wipers (49) Flap valve, cold air injection to de-icing system.

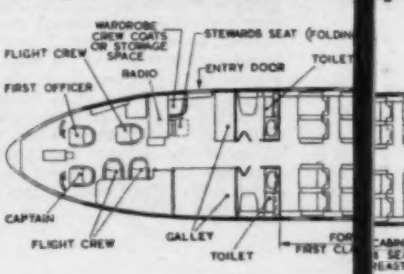
Air Conditioning and Pressurization: (50) Cabin differential, 8.75 lb per sq in (51) Ram air intake (52) Heat exchanger (53) Cold air unit (54) Silencer and humidifier (55) Pressurization packs (56) Rising duct in centre bulkhead (57) Air to floor-level grills (58) Recirculation-air venturi (59) Dump valves (60) Inward relief/safety valves (61) Conditioned air to cockpit (62) Warm air to windscreen (63) Ground-air connection and duct.

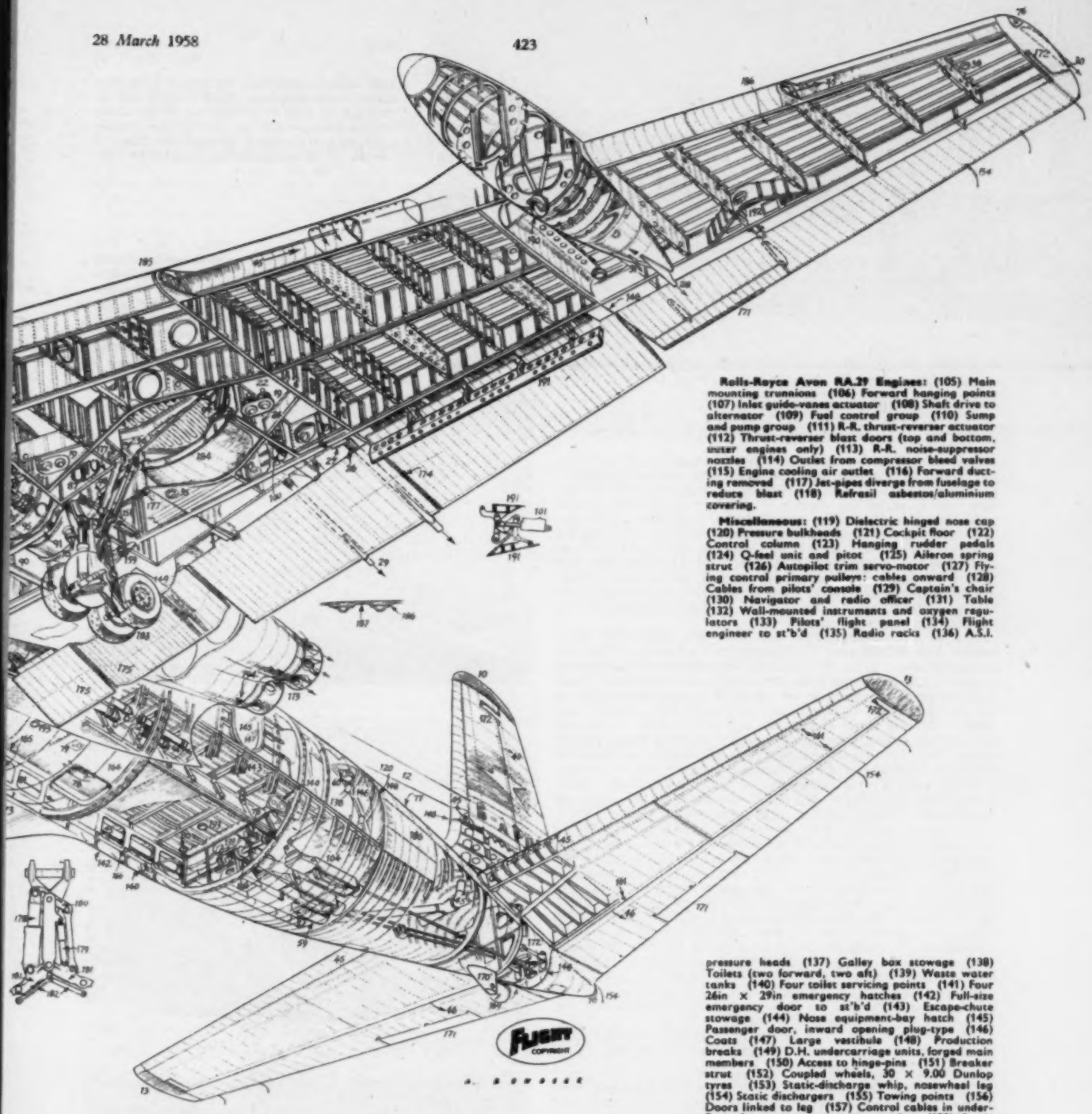
Electrical: (64) Four 14 kVA alternators (65) Two busbars (66) Rectifiers (67) Starter motor (68) Electrical service bay batch (69) Six 24 V 25 a.h. batteries (70) Main inverters (two) and stand-by (71) Main distribution panels (72) Ground supply sockets, two 28 V, one 112 V (73) Taxi lamps (74) Taxi and turn-off lamps (75) Landing lamps (76) Navigation lights (77) Anti-collision lights.

Fire Protection: (78) Smoke detector units (79) Extinguisher application points (80) Gallery and CO_2 spray points (81) Underfloor ventilating ducts (82) Inertia switches in nosewheel bay (83) Engine zone No. 1 (84) Engine zone No. 2 (85) Crash-deflection switches (86) Methyl-bromide bottles, zone No. 1 (87) Methyl-bromide bottles, zone No. 2 (88) Firewire system, includes doors (89) Ten temperature-sensitive switches each side (90) Firewalls (91) Lower half removable for engine installation.

Hydraulics: (92) Hydraulic service bay batch (93) Reservoirs, accumulators, electric pump, cut-outs, selector valves (94) Accumulators—yellow, emergency system and power-control backing accumulators (95) Four engine-driven hydraulic pumps (96) Nosewheel jack (97) Steering Servo-dyne (98) Mainwheel jacks (99) Wheel door Servo-dyne and accumulator (100) Flap servo units (101) Air brake jacks (102) Maxaret brake-units (103) Aileron servo-unit bay (104) Elevator and rudder servo units.

The Comet 4's two cabins lend themselves t... pitch. De luxe layout (sleeperettes at 56in... seating allows for 81 economy-class seats. ... forward, 43 tourists aft (this arrangemen...

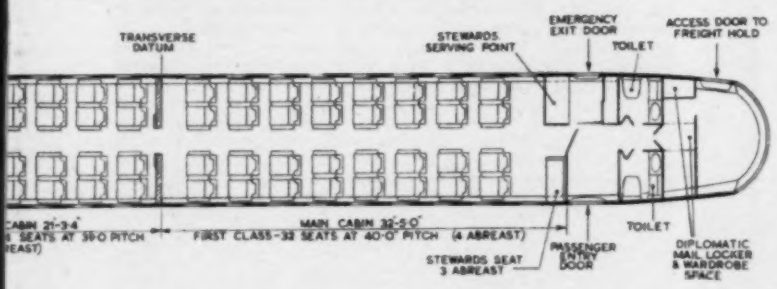


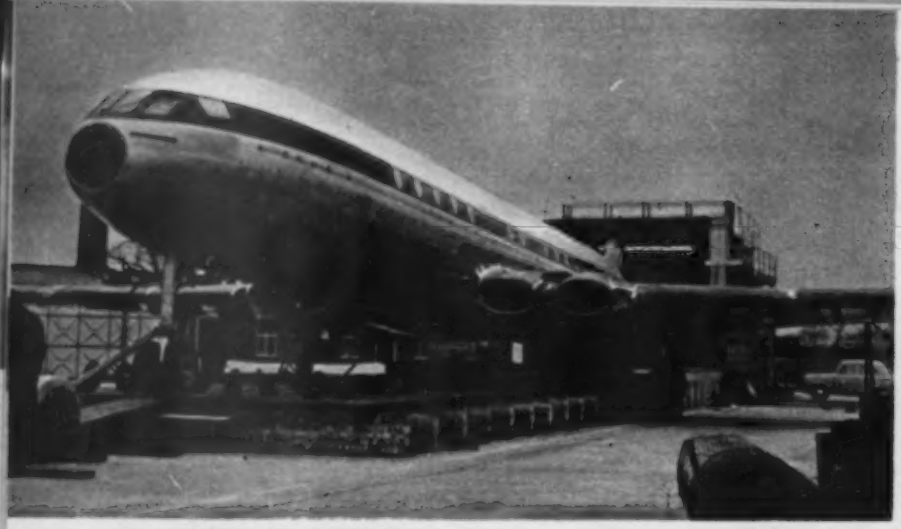


Rolls-Royce Avon RA.29 Engines: (105) Main mounting trunnions (106) Forward hanging points (107) Inlet guide-vanes actuator (108) Shaft drive to alternator (109) Fuel control group (110) Sump and pump group (111) R-R. thrust-reverser actuator (112) Thrust-reverser blast doors (top and bottom, outer engines only) (113) R-R. noise-suppressor nozzles (114) Outlet from compressor bleed valves (115) Engine cooling air outlet (116) Forward ducting removed (117) Jet-pipes diverge from fuselage to reduce blast (118) Refrasil asbestos/aluminium covering.

Miscellaneous: (119) Dielectric hinged nose cap (120) Pressure bulkheads (121) Cockpit floor (122) Control column (123) Hanging rudder pedals (124) Q-feel unit and pitot (125) Aileron spring strut (126) Autopilot trim servo-motor (127) Flying control primary pulleys: cables onward (128) Cables from pilots' console (129) Captain's chair (130) Navigator and radio officer (131) Table (132) Wall-mounted instruments and oxygen regulators (133) Pilots' flight panel (134) Flight engineer to st'b'd (135) Radio racks (136) A.S.I. pressure heads (137) Galley box stowage (138) Toilets (two forward, two aft) (139) Waste water tanks (140) Four toilet servicing points (141) Four 26in × 29in emergency hatches (142) Full-size emergency door to st'b'd (143) Escape-chute stowage (144) Nose equipment-bay hatch (145) Passenger door, inward opening plug-type (146) Coats (147) Large vestibule (148) Production breaks (149) D.H. undercarriage units, forged main members (150) Access to hinge-pins (151) Breaker strut (152) Coupled wheels, 30 × 9.00 Dunlop tyres (153) Static-discharge whip, nosewheel leg (154) Static dischargers (155) Towing points (156) Doors linked to leg (157) Control cables in underfloor ducts except at centre section (158) Static apertures on skin (159) Jacking points (160) Sockets for datum levelling bar (161) Sockets for rigging sighting rods (162) Freight hold doors on bunges cord (163) Oxygen bottles (164) Hold capacity—front 172 cu ft, rear 246 cu ft (165) .030in glass-fibre wall and roof liners; alloy floor (166) Lashing points (167) Fuselage/centre-section links (168) Elevator and rudder cable compensators (169) Rear fuselage access hatch (170) Tail bumper with mooring point (171) Servo tabs (172) Mass balance (173) Dinghy stowage (174) Scissor link between plain flaps (175) Split flaps (176) Forged intake rings in spar web (177) Undercarriage beams (178) Main shock-absorber strut (179) Damper shock-absorber strut (180) Rocker arm (181) Articulated axle beams (182) Brake torque rods (183) 36 × 10.00 Dunlop tyres (184) Door closed except during retraction or extension, st'b'd shown disconnected (185) Spar joint and dihedral from Rib 7 (186) Stringers Reduxed to skin, ends riveted (187) Extensive use of machined skin on inner wings (188) Flow spoiler (189) Fixed aerodynamic slot (190) Nylon bumper-wheel in nacelle tanks (191) Air brake surfaces top and bottom (192) Bay for aileron operating mechanism (193) Internal light (194) Fuel drains (195) Fresh-water servicing point (196) Fresh-water tank in roof (197) Basic skin 18 s.w.g. (198) Skin around cut-outs 16 s.w.g. (199) Gyro compass master-unit stowage.

merous one-class or mixed-class layouts. This shows the all-first-class layout—56 seats at 40in vides for 40 seats. Tourist seating (five-abreast) accommodates 71, and maximum "7.34" typical mixed-class layouts are as follows: 16 de luxe forward, 48 economy aft; 24 first-class ng B.O.A.C.'s present plan for Australian services). The total hold capacity is 418 cu ft.

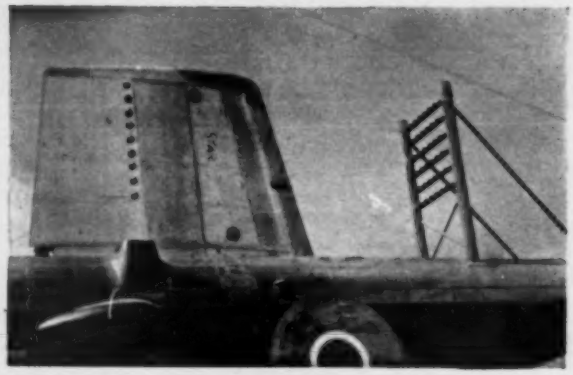


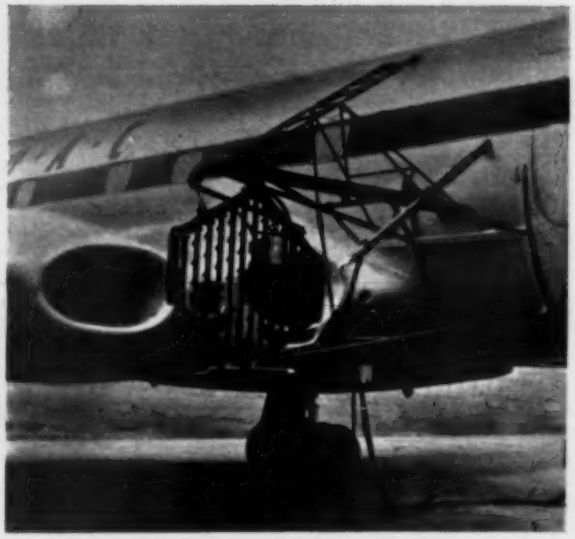


Last week, as seen here, the second production Comet 4 was moved into the D.H. water tank at Hatfield for final verification of all the detail fatigue-testing which the structure has already undergone. The aim is to clear the Comet 4 family of jet transports for a 30,000 hr life.

Below is seen a section of the Comet 4 tailplane mounted on the back of a Lincoln for subjection to heavy icing conditions. This work has been undertaken by Napier, designers of the Spraymat de-icing system. The lower picture shows the ice-making apparatus fitted to the old Comet 2X (Comet 1 with Avon engines) to test the engine's characteristics in heavy icing.

COMET RESURGENT . . .





cockpit control of this complex system is simple in the extreme, and almost fully automatic. The duplicated pressure controller, by Normalair, owes much to AiResearch experience. It is necessary only to preset the altitude at which it is required to start pressurizing, and the rest—temperatures, mass-flows, recirculation (no longer by a separate fan but by injectors all along the cabin), cabin rate of climb—is automatically taken care of. Two cold-air units made by D.H. Propellers under Hamilton Standard licence are fitted. De-misting and de-icing of the pilot's windscreens is now accomplished by glass with transparent electrically heated elements on the flat panels. Similar elements provide de-misting on the other panes.

The de-icing arrangements have also been thoroughly overhauled, with the objective of clearance for the heaviest icing conditions envisaged by the British Civil Airworthiness Requirements, for both the airframe and Rolls-Royce Avon RA.29 engines. These axial compressor engines do not consume ice so imperturbably as did the old Comet 1s centrifugal-compressor D.H. Ghosts, and special tests are being carried out at Hatfield with a spray-rig (see accompanying photograph) on the original Avon-engined Comet 2X. The Napier company are contributing considerably to the development of the airframe de-icing system: a Lincoln is being flown with a portion of the Comet's tailplane—which incorporates the Napier Spraymat—mounted on its back for de-icing tests, as shown in the upper picture on the right.

The control cabin of the Comet 4 is without doubt the neatest and simplest of any large transport to date. The old Comet 1 was considered by flight crews to be exceptionally good: the cockpit of the new Comet 4—which owes a good deal to the advice of B.O.A.C.'s Comet fleet—could scarcely be bettered. The most noticeable change is the use of grey instead of black panels, American-style. All the instruments and controls stand out much more clearly, especially on the flight engineer's panel—one whose arrangement is worth singling out for special mention. Presentation of systems—e.g., electrics and fuel—conform as closely as possible to the "sense" of the systems themselves.

Although not applied to the Comet 4, the pilots' windscreen panels on the 4B (and no doubt the 4C if it materializes) are deepened by 4in to improve visibility.

The fuel system has been re-engineered quite extensively, the main improvements being to "foolproof" the blow-off valves of the pressure-refuelling system, and also to provide an independent fuel feed to each engine. No one fuel pipe is common to two engines, as it was in the Comet 1.

Rolls-Royce have built this "fire tunnel" at their Hucknall test establishment to prove the Comet 4 RA.29 installation's resistance to, and ability to deal with, fire. See text in col. 2.

The Comet 4 came under the close scrutiny of America's Civil Aeronautics Administration after Capital Airlines placed their now cancelled order. One of the points to which they gave special attention was the safety aspect of buried engines. They expressed no objection in principle to this kind of installation, but required practical demonstration of the fire-characteristics of the Comet's engine installation. As a result Rolls-Royce constructed a special "fire tunnel" at their Hucknall establishment (see left) containing a Comet 4 stub-wing complete with engines. All possible causes of fire have been applied during the tests, which are still in progress but have so far been perfectly satisfactory. The combustion-zone of the Comet 4's RA.29 installation is now, incidentally,

completely encased in titanium, and all fire detectors are of the Graviner Firewire type.

Rolls-Royce have made other important contributions to the Comet 4, in particular to the suppression of its noise (by an amount sufficient to have already satisfied the Port of New York Authority), and to the reversal of thrust for landing. The latter installation is not yet sufficiently developed for inclusion, as was at one time hoped, in the first of B.O.A.C.'s 19 Comet 4s, but it will be fitted retrospectively to those aircraft. The prototype Comet 2X has undergone ground tests with a prototype reverser, and the prototype Comet 3 is at present being equipped with reversers (on the two outer engines) for actual landing tests which will be made during the coming summer.

Finally—and most important from the point of view of selling the Comet to the passenger—the interior has been completely restyled for B.O.A.C. In accord with modern interior-styling practice the Comet 4's cabin represents a complete breakaway from the Corporation's traditional, and rather dull, dark blues and greys. Much use is made of colour, with a result which—judging by the impression which the mock-up gives—will more than match the "jet-age décor" which B.O.A.C.'s American airline rivals are introducing. The actual seating layout is of course flexible, the structural bulkhead in line with the wing spars forming a natural division for the different classes. B.O.A.C. have numerous schemes in mind: they will probably begin their Comet services to Sydney with 16 passengers forward in 56in pitch *de luxe*, four-abreast seats, and 43 passengers aft in 40in tourist, five-abreast seats. Any number of permutations of seating layout for the various classes of passenger can be played by B.O.A.C. (maximum "economy," or T-34, seating, if installed throughout both cabins, would be 81). D.H. have achieved the utmost possible flexibility of cabin layouts by providing lavatories and pantries both forward and aft in the cabin. An accommodation diagram appears on p. 423.

Five years will have passed between last deliveries of the old Comet 1 and first deliveries of the new Comet 4. Those years may have seemed long to the many who have wished impatiently to see the Comet re-established in service and ordered by overseas airlines. But the time has been well spent, to a degree which tempts one to say that if any of the new airliners is likely to give trouble-free service from the word go, that airliner will be the Comet 4.

FLIGHT TESTING THE COMET 4

IN a week or two's time the fruition of three years' design and development work, and of 50,000 hours' flying, will emerge from the de Havilland factory at Hatfield in the shape of the first production Comet 4 for B.O.A.C., G-APDA.

Normally, production aeroplanes issuing from the de Havilland assembly lines are not the concern of experimental flight-test, whose responsibility for developing the prototype is usually discharged by the time the first production aeroplanes appear.

The first production Comet 4, however, is sufficiently different from its progenitors as to require an "experimental" flight-test programme rather more elaborate than a normal production test. This programme will not be as lengthy as it might have been without the existence of the Comet 3 prototype, now 3¼ years old and with 830 hours (in 581 flights) to its credit. Had the Comet 3 never been built, D.H. would have been confronted with perhaps a two-year programme of Comet 4 flying. As it is, they hope to have it ready for delivery to B.O.A.C. within 18 weeks of its first flight, in September of this year.

About 250 hours of Comet 4 test-flying should qualify the aeroplane for its full certificate of airworthiness. The distribution of these hours into various kinds of flight test work will be outlined in a moment: first must be recorded the indispensable contribution made by the Comet 3.

The prototype Comet 3 made its first flight at Hatfield in July, 1954, during the dark days of the Comet 1 investigation. Its future as a production aeroplane was uncertain for a year and a half, until in February 1955 B.O.A.C. placed their revitalizing order for an improved Comet, to be designated Comet 4. This New Comet, of which B.O.A.C. ordered 19, was to be the embodiment of all the experience and knowledge acquired, at such cost, to that date. D.H. reckoned that it would take three years to complete the transformation of their jet airliner, a measure of the amount of design and production work that lay ahead (see previous article). This estimate, though de Havilland have worked hard to reduce it, has in the event proved just about right.

Throughout this period, the responsibility of the experimental flight-test organization has been the testing and evaluation of the Comet 3 prototype in terms of the new Comet 4. Undoubtedly the greatest single advantage of the Comet 3 has been its aerodynamic identity with the 4. This has permitted D.H. to satisfy themselves in advance about the performance, stability and handling characteristics of the new Comet 4.

Though aerodynamically identical, the Comet 3 was unrepresentative in some fundamental respects—in particular, in its power, structure and weight—and it was untypical in many lesser respects also, e.g., in its systems and equipment. About a year ago, when Comet 4 redesign-work was well advanced, it was decided temporarily to withdraw the Comet 3 from flight tests and to make it as fully representative of the 4 as it could reasonably be made. This work, which began in July 1956, took seven-and-a-half months to complete. This reworked Comet 3 was dubbed the "3¼." Actually, except for its structure (which could not have been much changed without building a new aeroplane) it was almost a Comet 3¼. The biggest change was to the engines: the Rolls-Royce Avon RA.26s of the original Comet 3 were replaced by the RA.29s of the 4, a modification which involved radical alterations to the engine-bays. Numerous other modifications were incorporated, mainly to the systems, in order to evaluate in advance new detail-design features of the Comet 4. (The flying controls system had already been amended to incorporate q-feel.)

This work made it possible to reduce the tests required of the first Comet 4 to the absolute minimum, and modifications to the Comet 3 will have saved D.H. possibly as much as a year on the whole Comet 4 programme.

Because the structure could not be much altered, there were certain operating limitations on the modified Comet 3. For example, it was designed for a maximum weight of 145,000 lb, whereas the

The three de Havilland pilots primarily concerned with the Comet flight test programme are (left to right) Peter Wilson, John Cunningham (D.H. chief test pilot), and Peter Bugge.

Of the 50,000 hr of Comet flying to date, some 5,000 hr have been in the course of makers' test flights. Members of the test team seen here (reading down) are E. Brackstone Brown, engineer; A. J. Fairbrother, aerodynamics; J. A. Marshall, instruments.

"Flight" photograph

"Had the Comet 3 never been built, D.H. would have been confronted with perhaps a two-year programme of Comet 4 flying . . ." The Comet 3 is seen on test from its Hatfield base.

COMET RESURGENT . . .

4 will be certificated for 156,000 lb. But the measurements and assessment of the Comet 3 inspire confidence in the behaviour of the Comet 4 beyond those limitations. It will, D.H. hope, be a straightforward matter of checking—a rather elaborate production flight test.

The actual Comet 4 programme will, according to present plans, be as follows. First—probably as these words are being read—the aircraft will undergo an extensive series of ground-functioning tests. All the systems, notwithstanding the hundreds of hours of rig-tests which have gone into their making, will be thoroughly checked according to a pre-arranged programme, especially those which could not be made fully representative in the Comet 3. For example, the flying control system, undercarriage, flaps and so on will undergo a large number of reversals, the electrical system will be subjected to a series of full-load checks, and the cabin air system will be run under simulated flight conditions. Next will follow fuel-flow calibrations and engine-runs, after which the first flight will be made.

The Air Registration Board require a minimum of 250 hours before full Comet 4 normal-category certification, of which at least 100 shall be under operational route-proving conditions. D.H. may be able to clear the aircraft in less flying time than 150 hours; but—as the next article relates—the balance up to 250 hours will be accomplished by B.O.A.C. No doubt the first few flights will be concerned with an assessment of the new systems—particularly the flying controls, which are mechanically quite different (mainly in respect of the emergency arrangements and the trimming) from any previous Comet, including the modified Comet 3.

There will follow an assessment of performance and handling, which will take the form of checks on Comet 3 results, plus items which could not be covered with that aeroplane because of its lower gross weight. For instance, high Mach number buffet-boundary will be explored, rough-air speeds will be checked, and handling at all c.g.s will be assessed throughout the speed range from the stall (including the ground stall at the higher weights) up to the limiting Mach number and i.a.s. In general, all the more critical handling characteristics found on the Comet 3—which the A.R.B. will have flown for 14 hours in its modified form—will be checked on the 4.

The performance evaluation will comprise spot-checks of Comet 3 results (e.g., a few cruise-consumption checks on the 40-odd done on G-ANLO) and of course there will be new performance measurements beyond the weight limit of that aeroplane up to the new maximum take-off weight of 156,000 lb. This will require further tropical trials in Africa, where the Comet 4 will probably also make a search for dry ice in the inter-tropical front. There is no anxiety that the RA.29 will be susceptible to these conditions, as was the reverse-flow Proteus; but its dry-ice behaviour will be checked nevertheless.

It should be recorded here that the Comet 4's take-off performance, which because of the aeroplane's plentiful power has always been good, looks like being well up on estimates, judging from Comet 3 results. And, as recently recorded in *Flight*, the basic weight of the first production aircraft has turned out to be considerably less than the brochure. In other words, range (or payload) is likely to be better than estimated.

In general, performance tests on the Comet 4 will amount to about 20 per cent of those done on the Comet 3. That aircraft will still be fully employed, not only for reverse-thrust landing tests, but also for such things as autopilot approach-coupler checks, of which at least 50 now have to be made before certification can be granted. And quite soon, no doubt, the Comet 3 will have its wing span clipped for an assessment to be made of Comet 4B performance.

It is difficult to estimate the amount of time which the A.R.B. will require for their flight evaluation of the Comet 4 before full certification is granted. But the D.H. flight-test department feel confident that it could be less than 10 hours—an encouraging indication of the amount of development which has gone into the new Comet, and the extent to which it will be taken as read.

B.O.A.C. AND THE COMET 4

Capt. T. B. Stoney, manager of B.O.A.C.'s Comet Flight.

MANY times during 1954, after the Comet 1 had been withdrawn from service, did one hear the question—particularly from B.O.A.C. crews: "When do you think the Comet will come back?" There never seemed to be any doubts that it would come back, so indestructible a symbol had the Comet become.

Though stunned by the way the Comet had suddenly fallen out of their lives, B.O.A.C.—literally everyone in the Corporation—did not lose faith in the aircraft. The Comet had inspired B.O.A.C.'s *esprit* and emotions as no other aeroplane had previously done. It was popular with crews, it swept in the traffic, it put B.O.A.C.'s name in front.

The air-transport industry has grown up a little since those days, and airlines are (to quote Mr. Donald Douglas) more interested in making money than headlines. The Corporation's new fleet of 19 Comet 4s should make both.

B.O.A.C.'s Comets will come back, in their new form, next September—nearly seven years after delivery of the first Comet 1, and more than four years after its withdrawal from service. As related in the preceding pages, the Corporation's new Comets will be virtually new aeroplanes, having twice the power, twice the range, a completely new structure and much improved systems.

According to present plans, B.O.A.C. will introduce the Comet 4 into service five months after taking delivery of the first aircraft in September. February 1, 1959, is the target-date scheduled for the inauguration of services to Australia. Comets are being put onto the Kangaroo service first in view of the partnership with Qantas; the Australian airline is due to take delivery of its Boeing 707-120s (bought largely with B.O.A.C.'s Comet 4 competition in mind) in May 1959. How quickly Qantas will establish their 707-120s in service after delivery remains to be seen; but Comets should dominate the Kangaroo route for at least four months. Comet 4s will be introduced at a four-times-weekly frequency, following the traditional Britannia 102 (formerly L.749A) route of London, Zurich, Beirut, Karachi, Calcutta, Singapore, Djakarta, Darwin, and Sydney. One of the four services per week will be routed *via* Colombo (Katanayaka), a service which is due to be inaugurated by Britannia 102s next month.

Britannia 102s will be completely and immediately displaced from the Australian route by Comet 4s, which will subsequently—starting in June 1959—displace B.O.A.C.'s medium-range turboprop from the Corporation's London-Tokyo route. By September 1959 Comet 4s should be handling most of the Far East services. Next, in January 1960, the Comet will take over the South African Springbok route, and by then the Britannia 102s will be relegated to the Corporation's services to East and West Africa, and those terminating in Pakistan and the Persian Gulf. There is a possibility—though B.O.A.C. do not confirm this yet—that Comets will reopen the Corporation's services to South America *via* the South Atlantic (suspended when Comet 1 capacity was withdrawn in 1954) in April 1960.

There have already been suggestions, as a result of PanAm's avowed aim to open transatlantic Boeing 707 jet services in October of this year, that B.O.A.C. should simultaneously introduce Comet 4s into transatlantic service. B.O.A.C. decline to be pressed on

achievement!

On August 28, 1957, at U.S. Naval Air Test Center, Patuxent River, Maryland, in the presence of Mr. Gates, Secretary of United States Navy, Admiral Thurston Clark, U.S.N., Commander Naval Test Center, and many U.S. Navy Officials, Flying Officer S. Hughes, R.A.F., ejected at runway level from a Grumman Cougar taking off. This ejection, the first from ground level in America, was done to demonstrate the Martin-Baker Patent Fully Automatic Ejection Seat at present being supplied for U.S. Navy aircraft. The upper photograph shows the main parachute streaming. On the right, Hughes, immediately after the ejection, is being congratulated by the designer of the seat, Mr. James Martin, C.B.E. Design features of this seat are patented in U.S.A. and Great Britain.

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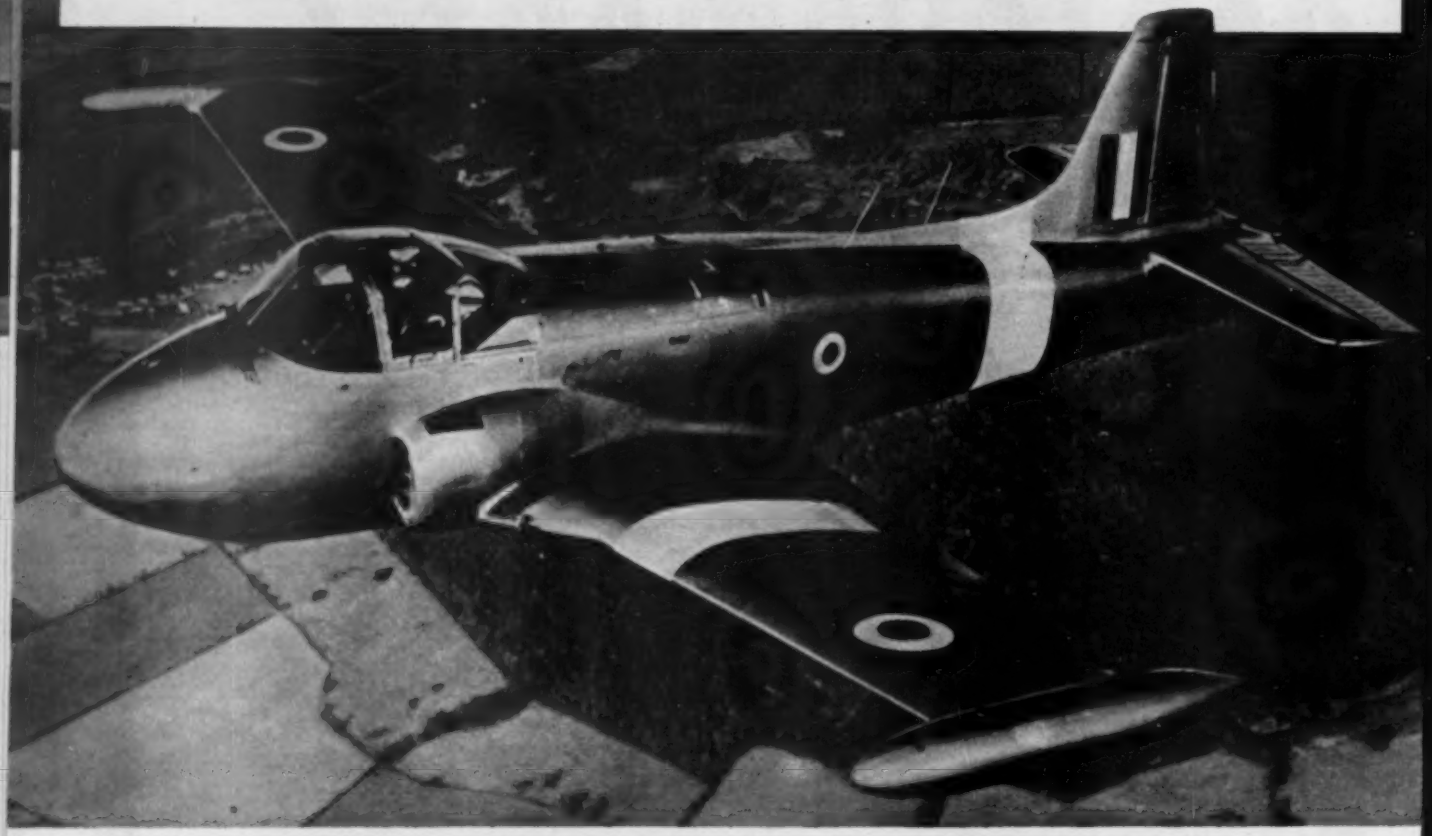

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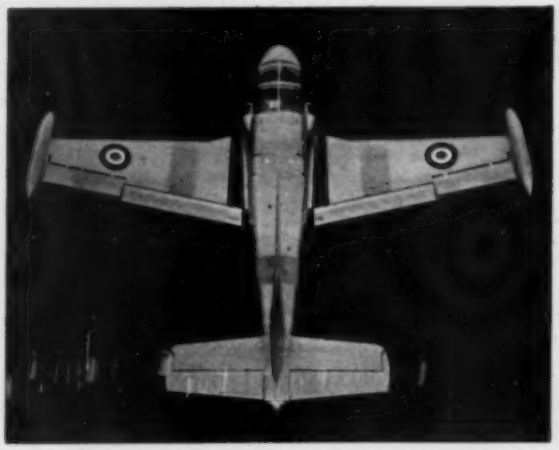
Sea level to 30,000' (9144 m) ... ... 23.0 mins.
Rate of climb at sea level ... ... 2380 ft./min. (12.2 m/sec.)
Max. level speed at 30,000' (9144 m)...286 knots (530 km/hr)
Range (with tip tanks) ... ... 490 n. miles (910 km)
Endurance ... ...2.45 hrs.



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AP309

Among the officers seen here, standing by one of B.O.A.C.'s two Comet 2Es, are (second from left), Capt. R. E. Millichap, deputy manager of B.O.A.C.'s Comet Flight, and (second from right) Capt. A. P. W. Cane. Formerly manager of the Comet Flight, Capt. Cane is now on the staff of B.O.A.C.'s general flight operations administration.

COMET RESURGENT . . .

this point. It has not been their intention to use Comet 4s on the North Atlantic, though they have looked at the aircraft's potential one-stop capabilities on this route. No doubt it would be a proposition, as a prestige-operation, but the Corporation is not likely to be easily persuaded—however great the political pressures—from its cautiously laid plans for introducing Comets on the Commonwealth routes.

Five months may seem an over-cautious length of time between delivery and service; but B.O.A.C.'s Comet Flight has set itself a training and route-proving programme of a thoroughness which even the most ardent prestige-protagonists would, in the light of B.O.A.C.'s past experiences, admit to be necessary. It is the Corporation's estimate that no less than 1,500 Comet 4 hours will have been flown between the time they receive the first aircraft from de Havilland in September to the time the first passengers are carried on February 1 next.

"Token" services would cause a severe disruption of commercial plans. It is B.O.A.C.'s intention that Comet services shall begin as a fully commercial operation right from the start. Four frequencies a week to Australia represents the most economical use of crews down this route, and makes it possible for the whole Comet operational machinery to be geared up to a realistic commercial speed right from the word go. But in order to mount such an operation at least half-a-dozen Comet 4s will be needed. B.O.A.C. expect to receive four before the end of this year from the Hatfield production line, with one or two more during January.

Thus B.O.A.C.'s choice of February 1 as the inaugural date for Comet services appears to be realistic, especially when additional time-allowance is made for the crew-training and route-proving programme. There will be eight route-proving flights to Sydney, accounting for about 600 hours, including local flying time down the routes. In addition, there will be a further 150 hours of "evaluation" flying under route conditions, 100 of which will no doubt meet the Air Registration Board's certification requirement referred to in a previous page.

All this accounts for 750 hours; in addition type-conversion flying will also account for 750 hours—making 1,500 hours in all before the first service.

The Comet fleet will eventually need 117 fully-trained crews to man its 19 aircraft. Each flight crew will comprise four men—two captains, a navigating officer, and an engineer. The actual requirements will be 261 pilots, 132 engineers, and 130 navigating officers. All 117 crews will, it is hoped, be trained within 18 months from the time type-conversions begin. The last aircraft of the fleet of 19 will be in service by December 1959 (the month in which B.O.A.C.'s first Boeing 707-320 is due to be delivered), by which time Comet crew-training should be nearly completed.

The requirement for the inauguration of services in February will be 24 crews. Comet-experienced pilots will have about 18 hours of route-proving, and those with more limited experience will get about 25 hours.

Initial conversion-training will obviously be for officers from the existing Comet 2E fleet (whose activities will be referred to in a moment). There are 21 Comet 2E captains, most of them ex-Comet 1 pilots, and including the manager of the B.O.A.C. Comet Fleet, Capt. T. B. Stoney, his deputy Capt. R. E. Millichap, the training officer Capt. B. G. Wallace, and other well-known former Comet 1 captains like Capt. E. E. Rodley.

All Comet 4 training flights will be based on London Airport, though circuits and bumps will have to be done elsewhere for obvious reasons. B.O.A.C. much appreciate the good relations existing with the airport staff, and many of the M.T.C.A. personnel have been given rides in 2Es to obtain first-hand experience of the A.T.C. problems—particularly jet problems—from the flight-crew's point of view. B.O.A.C.'s Comet 2Es have never been refused special facilities (e.g., an I.L.S. approach and overshoot) when sought; but obviously intensive training-sequences involving numerous take-offs and landings cannot be done around busy London. One likely alternative, with its excellent 10,000ft runway, is Stansted. Hurn—where Britannia crews are trained—may be too far away: an hour's dead flying (in between refuelling) at Comet consumption rates, even with jet fuel at 1s 5d a gallon, could be an unnecessary expense. An important advantage of London-based conversion-flying is, of course, the convenience with which simulator-training can be co-ordinated with actual flight-training.

Depending upon their previous Comet experience, type-conversion to the Comet 4 will require pilots to spend about ten hours on the flight trainer (not to be confused with the more elaborate Redifon flight simulator) and up to 12 hours in the air. Time in the air will, of course, be substantially reduced when the Redifon simulator is delivered before the end of the year.

About 18 of B.O.A.C.'s 261 Comet 4 pilots will be raw recruits. Because the Comet will be their first transport type, their training will be more elaborate, extending over a period of about eight months.

The Comet 2E has played an essential rôle in the B.O.A.C. Comet story. Two of these aircraft were delivered to the Corporation in August 1957, as the first stage in the long-term Comet 4 plan (see "Callsign Jet Speedbird," *Flight*, October 4, 1957). These two aircraft were fully modified production Comet 2s, similar to the ten previously delivered to R.A.F. Transport Command, with one important exception. The two outboard Rolls-Royce Avon RA.9 engines were replaced with Avon RA.29s, the object being to amass engine development hours while at the same time permitting B.O.A.C. to rebuild their Comet operations well in advance of Comet 4 deliveries.

By the time these words are read the two Comet 2Fs will have completed about 2,700 flying hours since they were delivered to B.O.A.C. in the latter part of August last year. The aim was to clear the Rolls-Royce Avon RA.29 for a 500-hour overhaul life before the start of Comet 4 operations: in fact, these engines have already—two months before the end of the 2E programme—been cleared for 750 hr. Moreover, the A.R.B. have given their approval for one engine in each aircraft to be run to 1,000 hr. Whether or not, as a result of the strip, the RA.29 will be formally cleared for 1,000 hr between overhauls remains to be seen. But the fact that a transport turbojet of 10,500 lb thrust is, at this moment, in the running for a 1,000 hr life is worthy tribute to its makers and operators.

When B.O.A.C. took delivery of their 2Es they set a target of 3,500 flying hours to be completed by May 31, 1958. Owing to delayed deliveries, the programme had started 150 hours behind-hand. This was made up by increasing the weekly programme of round-trips to Beirut and back (or equivalent London-based single flights) from eight to eleven. In the event—thanks to the excellent serviceability of both the aircraft and its engines—the 3,500 hr programme will be completed by the end of May, according to the original schedule.

The aim has been to amass 125 hr per wek with the two 2Es, i.e., 9 hr utilization per day per aircraft. Often it has been more than this (in one recent week, for example, 13 round-trips between London and Beirut were made instead of the usual 11). Rarely has utilization been less than 9 hr per day, except when weather or training requirements have intervened.

The operation of jet transports at this rate for six months has obviously resulted in more than the proving of the RA.29 engines. Though dormant for three long years, B.O.A.C.'s Comet 1 experience (30,000 airline hours) has been thoroughly refreshed and reassessed in the light of today's operating conditions. The Comet 2E programme has also helped the Ministry of Transport and Civil Aviation, with whom there has been close liaison in such matters as high-level jet holding patterns, climb and descent procedures, *en route* cruising techniques, evaluation of Decca, and so forth. Soon, when their work on behalf of the Comet 4 is completed, the 2Es will co-operate with the M.T.C.A. in a new programme aimed at tackling the whole problem of integrating jet and conventional transports into the country's air traffic pattern.

Thanks to the Comet 2E, B.O.A.C.'s Comet Flight—to borrow a phrase from the U.S. Strategic Air Command—is at a high state of readiness, and the transition to Comet 4s should be smooth.

When Homers Pod

SOME THOUGHTS ALOUD ABOUT JET TRANSPORTS

By FAVONIUS

"And they asked me how I did it, and I gave 'em the Scripture text,
'You keep your light so shining a little in front o' the next!'
They copied all they could follow, but they couldn't copy my mind,
And I left 'em doodling and dawdling a year and three pods behind."
(Kipling—updated)

WHETHER or not they recall the pseudonym "Favonius," many readers of this article will recognize the highly characteristic style of a writer who used to contribute regularly to our pages. It should be added that "Flight" does not necessarily associate itself with his opinions.

REVERBERATIONS of shot-gun weddings arranged by a paternal British Government on behalf of its aircraft and airline industries have been heard around the world. But more penetrant than the sound and heat generated therefrom is the light playing upon one of the partners in this overplayed charade. With B.E.A. long baulking at the hitching post, its unwanted jet offspring is bound to be late at the winning-post—so much so as to be hardly worth betting on. The reluctant father, once cosily (if complacently) married to what looked like a turboprop spouse, started flirting with a fast French femme, the attractive Mlle. Caravelle, and so got shot-gunned by the march of events into the jet stream. Having done so, it was still something of a shock to find that the tarnished chastity of that Continental liaison—whereof podliness takes precedence over cleanliness—gave birth to almost identical triplets.

As I see it, this latter irregularity is an even more portentous manifestation of shot-gun gangsterism, for here we see the Government servant ganging up on the aircraft designer. The conclusion seems all too apparent: the righteous father, having made sure of the marriage—after promise of substantial dowry—passes on the shot-gun to Big Brother of the airline corporation, who then proceeds to master-mind the design offices and to conjure up the configurations. Supposedly proffered in the first place by three independent design teams in closed tender to B.E.A., we are confronted with a striking similarity that stretches beyond the coincidental.

How Many Cooks?

At first sight, this scrambled uniformity looks suspiciously like a BEA is someone's bonnet, since the harmonious hum at the tail-end was not always there. It is well-known that at least one of the three finalists, probably with one eye already cocked on the American market, started with a four-jet scaled-down version of the Boeing 707, doubtless mixed with a dash of DC-8. And it would seem highly likely that de Havilland would have started out with their own well-tested Comet layout. But apparently the allure of the French line, which admittedly does have some decisive advantages over the American fashion of wing podding, won the official favour. Nevertheless, in view of the encouraging status of jet-flap research, any form of external poddery is retrogressive because it stymies the effective use of the jet efflux. It is a stunning revelation of what can happen to the jet design art when airline (and other) civil servants get their fingers too deeply into the designer's pie. I submit that while the national airline official, as the customer, is the proper man to write the specification, and to that extent must control the ingredients, he has little business in formulating the recipe, and none at all in shaping the dish and cooking the confection. (No one will deny him the right, however, to comment on the performance of the pie—that is, the taste—once it reaches his palate.)

If this is to be the unsound wave of the future, with the manufacturer playing the tune to music composed and conducted by the airline corporations, then the stark and dismal moral should be all too clear to the talented young aircraft designer with a creative bent for doing something more original than copying contemporary styling, since the latter as now seen in the flesh (or hardware) was actually a dream on a doodle-pad some five or more years earlier. The only way you can keep abreast of the art is to be a jump or two ahead of it on the drawing board. (Looking at many of the current crop of proposals for civil aircraft for the next decade, particularly turboprop freighters, it is patently obvious that their creators are looking backward, not forward.) And so in these handcuffed conditions I would recommend our newer design recruits not to waste their time doodling in an aircraft D.O., but hasten to join up with one of the several Ministries or national airline corporations. Become a "chosen instrument" that leads to the Board room and steer clear of the board that may lead to boredom—hatching some other cuckoo's eggs!

History, like the Parisian fashion parade, is entitled to repeat itself, of course. And so old-timers will recognize that this is where they came in—with a Government factory and design staff practically painting the designer's canvas and then framing it for him. (Shades of Charles Grey and Pemberton-Billing, arise and mock this mockery of remote control by conferenciers not charged with design responsibility.) Once more—unless we are going to repeat the mistakes of history—we have to place the responsibility for design squarely on the manufacturer, whose job it is to deliver the goods on time and up to spec. Co-operation in the form of operational advice from the airline, yes! But domination of design motif, never! If British aircraft firms are satisfied with this big-brotherly interest in cutting their cloth for them, I suggest they will eventually end up as dummies in a tailor's shop with "National Aircraft Factory" sign-painted over the portals.

Assuming that the D.H. 121 design turns out to be the winner of this podly trinity—which, by virtue of de Havilland's unflinching faith in the jet, seems fair enough—one must now face up to the unpalatable fact that the pioneer Comet configuration (beyond the Comet 4, that is) has been effectively killed off, or at least road-blocked for a long time to come. Meanwhile, on the ironic side of the curtain, the Russians still seem to favour the wing-root jet installation; thus the student of contemporary design practice may be baffled seeking a clue to the follow-the-queue poddists now lining up from Europe to America. Why is peduncular poddery, whether wing- or afterbody-located, now so predominant as to look almost pre-ordained by the gods of the aerodynamic copybooks? And why the almost overnight conversion on the part of British designers from jet burial in the wing to jet barrels in the wind? I believe that one must re-examine the Comet 1 inquest, verdict and aftermath to sense just how the aerodramatics of yesterday are now affecting the aerodynamics of today.

On sifting the evidence, then and since, one becomes aware that it would be unfair to single out any particular "someone" in either of the national airline corporations for changing over to pods; in reality, a much wider connotation is in order, with its focal point at Farnborough. I suspect that this technical expertise has been subtly influenced by one of the more softly-pedalled side issues arising from the research on pressurized fuselage fatigue—the deleterious pulsating effect (or rumble) of the jet efflux along the side of the afterbody caused by the inboard engines in the wing root. At the time of the Comet inquiry one had the feeling that this aspect of the fatigue investigation did not receive quite the attention that it merited. Since the problem, however, was being experienced on certain types of military jet aircraft, designers in the industry and R.A.E. technicians have undoubtedly given considerable thought to obviating or lessening this source of vibration. Elimination of wing-root engines altogether is an obvious answer, although an uninspired one in my view.

Decent Burial

Today, it shouldn't take much imagineering to visualize a neater and more effective solution to the buried wing-root engine installation—modify the jet-pipes to play a softer and more harmonious tune; don't leave them proudly parasitic at the wing root, but flatten them out and exhaust the gas stream in a horizontal ribbon through the inboard trailing-edge of the wing—the practical half-way house to the jet flap, of course. And since engineering design is essentially a stepping-stone process, it would seem an eminently sensible way to introduce this highly promising scheme, rather than to attempt too much at one time and run into a snarl of time-consuming snags. For one thing, it must be obvious that cross-coupling of the flap jet on each side of the fuselage is the first practical problem to be solved, which is another reason for a moderate flap span to start the engineering ball rolling—but not the aircraft, we hope! Needless to say, it will never be solved if we accept the engine pod as an isolated entity. Integrate and add more lift—as well as built-in safety.

Finally, let me categorically state that I have no objection to tri-jetting *per se*; indeed, I believe I was one of the first to suggest it in the technical Press and, in doing so, evoked a whimper of protest from the "four beer-barrels abreast" school of orthodoxists. My real quarrel with the barnacled-behind believers is their paucity of imagineering in dragging behind in the jet design art instead of getting slightly in front of it during the initial planmanship ploy—especially so in view of the late timing (1964) now on the planning chart. Although right now the Caravelle is an excellent design for *its* timing, all this rear-end copycatting is as outdated as wing podding. For while the Homers pod, the jet-wing-flap lies buried in the bulrushes.

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Straight and Level

"WHAT'S the trouble with rockets?" asks the *Sunday Express*. *"Why can't America put rocket-lifted sputniks into space as easily as the Russians seem to do?"* I will answer that question by asking another: "Why don't the Russians allow photographs to be taken of their rocket failures, and published in a free Press?"

Just look at the spectacular mission of a North American XSM-64 Navaho at Cape Canaveral, recorded below (the giant Mach 3.5 vehicle was in the air a bare minute). I know it wasn't part of the U.S. earth-satellite programme, past failures of which have likewise received maximum publicity. But if I belonged to an "uncommitted" country, whose heart the West was trying to win, I think I would be more inclined towards the country which freely allowed its failures to be publicized.

We are, I suppose, building rockets in order to defend the freedom to publicize the failures of our rockets.

● A recent *Flight* leader suggested mixed power for missiles, as steam and sail were mixed in early warships. Thinking along the same lines is the chief of the rocket engine branch of N.A.C.A.'s Lewis Flight Propulsion Laboratory, who has declared that "Arc-jets, ion-thrust, plasma accelerators and photon sail engines are most promising . . ."

The technical editor tells me that a photon sail engine works, roughly speaking, on the principle of those little black-and-silver vanes that spin round in the sunlight through the windows of opticians' shops. Could the N.A.C.A. chief's name have any bearing on his interest in this particular power-source? It happens to be John L. Sloop.

● The other day I was talking to an overseas airline executive about business relationships with aircraft firms. He did not put too fine an edge on his views. "Instead of getting information straight from the horse's mouth," he said, "we often get it from other quarters."

In other words, customers like to get into the design offices. If the design people say, "Sorry, too busy," it follows that they will not be busy for long.

Mind you, there are some design teams who reckon they ought to do sales themselves. One British chief designer I know calls his firm's sales department the "allow-to-buy department."

● Most of us must have collected cigarette cards in our younger days, and such things are now also found in chocolate bars, soap packets and boxes of cereals. In the main the information which they convey is commendably accurate. But I have come across a masterpiece of invention worth recording here. I won't say where it is from, but the offending publication is a tiny booklet of pictures of modern transport. Several of the captions are naïve in the extreme, and about half are quite unrelated to their illustrations. Best of all, however, is a representation of the Northrop YRB-49 eight-jet experimental bomber. The caption says "Called the Flying Wing, this Air Liner appears to have no body. Will board 200 passengers, and runs a regular route from Croydon to Chicago." This clinches it—Croydon just MUST be kept open.

● When one of my colleagues was in the Royal Air Force he was never happy during postings to places where there was no airfield. He felt a distinct lack of purpose about depots and hutted camps—a lack which could only be dispelled by the squat outlines of hangars and the smell of kerosine. It is a similar feeling, I imagine, which prompts our wiser aircraft firms to spend a lot of money in taking technicians from their work and strapping them into their aeroplanes and letting them see how things perform. A thoroughly good idea, if one accepts the fact that such flying is not necessarily intended to be instructional; it just gives a man a much greater sense of importance and accomplishment.

So pity the poor guided-weapon technician. Lots of them would gladly fly in one of their creations if they had the chance, 40 g and all. Talking to a man who had held important and responsible posts with five g.w. firms, I learned that most g.w. designers never leave their drawing boards to "watch things." The particular designer I was talking to had *never seen a missile fired*. . . . "Just once," he wailed, "that's all I want."

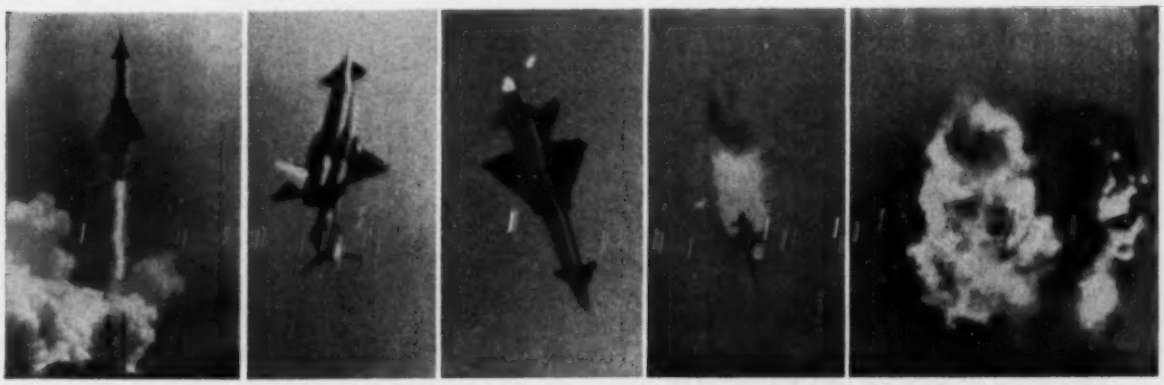
● There are few things quite so valuable as a man—or woman, for that matter—who is supremely competent at his or her trade. The touch of a master's hand can bring rare music from the oldest beer-filled piano that ever stood in a bar; and a good designer can see straight to the heart of a problem and produce an answer—the right answer—in a tiny fraction of the time needed by a special staff assigned to the same problem.

By the same token, it takes but a few minutes for an incompetent person to wreak havoc. Suppose a company wishes to include some performance curves in a brochure: a competent engineer can sketch what he wants in a moment, but he will later have to spend days rejecting the "properly drawn" results owing to the fact that the artist completely fails to sense the significance of some minor detail. And another point worth mentioning is that it is fatal to give executive power to a committee unless the majority of its members really do know what they are voting on; all too often a major decision is made quite wrongly by men who "believe" or "have ideas," when a single truly competent man can show them exactly how wrong they are.

● "What are the relative merits of the British and metric measurement systems?"

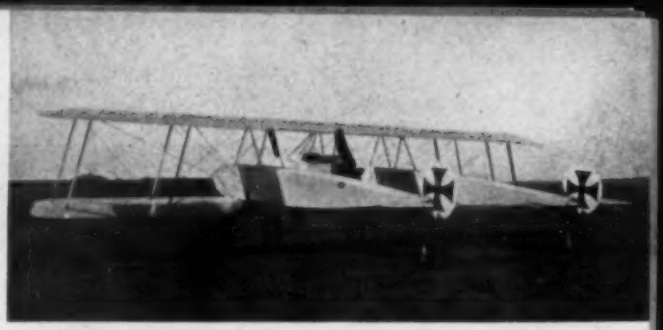
"Oh, I don't know, six of one and fifty per cent of the other."

ROGER BACON



Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.



Fokker M.9 or K.1 (see letter from Mr. H. A. Somberg).

The Britannia

MAY I make one or two comments upon your timely leading article (March 14), "Britannia at the Crossroads"? Whilst it is broadly correct to relate as you do the 400 redundancies at Bristol with further production of this machine, we are not in fact dealing with a figure of 400 but rather of 600, with the possibility of more.

The most serious aspect, I suggest (it having been already made public), is the fact that some 200 draughtsmen and technicians are to be dismissed from Bristol's London design office. Thus, your suggestion for a major modification to the Britannia, to produce as you put it "a convertible *par excellence*," would presumably need to be put in hand without delay before the design potential is further reduced.

In any event, one would think that the Government's almost contemptuous cancellation of any further development of the Orion engine when it was already revealing itself as a unit of remarkable efficiency and economy, was a clear indication that they are not interested in the maximum development of this fine machine.

Finally, one must comment on B.O.A.C.'s attitude towards their Britannia profits. This is surely a case of "Is my face red!" After all, the Corporation in its own subtle way joined in the popular sport of a few months ago—"baiting the Britannia."

You will recall that the immediate reaction of the Corporation to the crash of the Prototype 301 machine last autumn was to announce that this would mean a further delay in the introduction of Britannias on Atlantic service. Was it not strange, therefore, that a very prompt about-face took place as soon as El Al reaffirmed, despite the accident, their faith in this aircraft and stated that their own Atlantic service would commence as planned? So, sir, did B.O.A.C.'s—though not with comparable frequency, as you say.

Bournemouth, Hants. F. E. G.

Jargonisation

MAY I, through the medium of your columns, protest against the insidious invasion of our vocabulary by pseudo-scientific words?

I have been at long last goaded into writing you this letter by a technical report on one of our most modern (and therefore most "scientific"?) aircraft which produced, firstly, the ghastly word "patternation" in discussing fuel-burner characteristics, and added "permittivity" for good measure but for no translatable meaning.

I have myself been given written flight instructions which told me of the "upliftment" of catering stores and of the "downsetment" of passengers. Certain of the catering stores were, of course, liable to "spillage," but I never did find out whether a failure to downset the passengers would have caused them "frettage."

Apparently, no longer can we be allowed to say "yes" or "no"; it must be "affirmative" or "negative." We often don't "climb"; we "ascend"; and how much quicker, more accurate and more pompous it is to say "at this time" rather than use that silly, nursery-day word "now"!

So, sir, will you please at this time give me handage in battlement against the usage of such a patternation of verbiage?

Liphook, Hants. L. B. GREENSTED.

Aviation Book Clubs

THE letter from "Literary Agent" (Correspondence, February 21) on the subject of aviation book clubs was much appreciated for the facts it contained.

The most significant fact was the minimum economic circulation of 3,000 which must also, I presume, have applied to the original Aviation Book Club. In the interim, probably the major change in book-reading habits has been the introduction of the paper-back which, although not universally popular, represents stiff competition. One wonders, however, with the co-operation that the publishers appear willing to extend, whether it would not be feasible to produce ABC editions in advance of cheaper publications. It seems logical on the face of it to publish editions in descending order of retail price.

Nevertheless, with the paper-back competition in mind and discounting any increased interest since the 1930s, a membership of 3,000 is still an appreciable target. But does not "Literary Agent" himself suggest a solution in his mention of the American Air Power Book Club editions at over twenty-six shillings each? With suitable advertising I would imagine that 3,000 subscribers to a British club could be enrolled in the United States alone with the rate of exchange so much in our favour. Dollar lolly, too!

This to me is the major problem—one of economics and potential business. I remain unconvinced that demand for the classics is insufficient to warrant reprints or that the paper-back excludes the best-seller. Surely the original Club faced similar, if not greater, problems?

I would like to feel that this project to revive the Aviation Book Club will be actively supported by the proposed Aeronautical History Society. Records, after all, are the basis of historical research and I hope that the Society will not only publish books of its own but will also encourage many who have played a part in the history of flying to commit their memories to paper. With regard to this Society I note that at the time of writing no one has publicly thanked the Kronfeld Club for their generous offer of accommodation; such a pleasant contrast to Mr. Cain's attitude. May I now suggest, nay, make an earnest plea, that a Bruce, a "Beltane" or an Andrews takes the next step of organizing a meeting to tackle the spade work—and that *Flight* will grant him a little space?

Windsor, Berks. C. JOHN BARRON.

German World War I Rarities

HAVING read in your "Correspondence" the items on "German World War I Rarities" I send you herewith a picture of the 1915 Fokker M.9 (military designation, K.1) which had a pusher-tractor tandem engine arrangement and two fuselages, in each of which an observer was seated. The M.9 was powered with two 80 h.p. Oberursel rotary engines. Only one prototype, as far as I know, was built.

H. A. SOMBERG,
N.V. Koninklijke Nederlandse Vliegtuigenfabriek Fokker.

Amsterdam.

IN his letter published on March 7 Mr. Smith refers to an aeroplane being known as the Fokker G-1. But I believe he commits a mistake, for the Fokker G-1 Le Faucheur was built in the thirties. I believe Fokker K-1 would be nearer to the mark. The pilot was placed in the central nacelle. A gunner was placed in each fuselage.

Rotterdam. G. J. DE BRUIN.

FORTHCOMING EVENTS

Mar. 27-28. Institution of Electrical Engineers: Radio and Telecommunications Section: Convention on Radio Aids to Aeronautical and Marine Navigation.

April 5. British Interplanetary Society: "Problems of Handling Large Missiles," by F. R. F. Taylor.

April 10. R.Ae.S.: Main Lecture: "Guided Weapons," by R. Cockburn.

April 11. Helicopter Association: "Powered Lift Systems," by Charles H. Zimmerman.

April 14-17. 15th Radio and Electronic Component Exhibition, Grosvenor House and Park Lane House, London.

April 15. British Institution of Radio Engineers: "Factors in the Design of Airborne Doppler Navigation Equipment," by E. G. Walker.

April 15. R.Ae.S.: Section Lecture: "The Problems of Vertical Take-off," by Dr. C. T. Hewson.

April 16-25. Instruments, Electronics and Automation Exhibition, Olympia, London.

April 21. Women's Engineering Society: "Philosophy of Guided Missile Design," by W/C. P. M. Chettle.

April 25. Institute of Navigation: "Use of Simulators for Training Navigators to Use Radar Equipment."

R.Ae.S. Branch Fixtures (to April 30):—

April 1, *Boscombe Down*, "Aircraft Accident Investigation," by E. L. Ripley; *Luton*, "Arctic and Tropical Trials," by R. K. Cushing. April 2, *Brough*, "The Beverley in Service," by G/C. F. C. Griffiths; *Christchurch*, "Casting Light Alloys," by Mr. Eade; *Weybridge*, "The Future of Nuclear Propulsion," by Rear-Admiral Sir Edward Rebbeck. April 3, *Isle of Wight*, "Contour Etching," by A. W. Sheppard; *Reading*, Brains Trust. April 7, *Derby*, "The Tyne Turbo-Propeller Engine," by D. McLean. April 9, *Chester*, "Air-to-Air Photography," by Russell Adams; *Glasgow*, A.G.M. and Film Show; *Swindon*, "History of the Supermarine Works," by A. N. Clifton. April 10, *Cheltenham*, A.G.M. and Film Show; *Yeovil*, A.G.M. and Film Show. April 11, *Hatfield*, Annual Dinner. April 14, *Helton*, "Aircraft Photography," by John Yoxall. April 16, *Brough*, A.G.M.; *Christchurch*, Joint Meeting with Institution of Mechanical Engineers: Lecture by G. W. H. Gardner; *London Airport*, "Titanium," by H. W. Shaw; *Preston*, A.G.M. and Film Show. April 18, *Birmingham*, "Reduced Aircraft Structures." April 21, *Helton*, Film Night and Committee Meeting. April 23, *Christchurch*, A.G.M. and Film Show; *Hatfield*, Discussion Evening; *Leicester*, A.G.M. and Film Show. April 30, *Reading*, A.G.M. and Film Show; *Weybridge*, A.G.M.

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The Law of Mediæval Space

PREPARING THE WAY FOR PEACEFUL EXPLORATION BEYOND THE EARTH

By HAROLD CAPLAN, D.C.Ae., A.M.I.Mech.E., A.F.R.Ae.S.

ORIGINALLY published in "Potential," the magazine of the College of Aeronautics, Cranfield, this article has been revised for "Flight" by the author, who is assistant secretary of The British Aviation Insurance Co., Ltd. The opinions expressed are the personal views of the author.

THERE was a time when the bosoms of loyal Englishmen (and women) might swell at the thought of intrepid Empire-builders rushing around the surface of the Earth planting Union Jacks in virgin soil for the honour of King and country. That pride has given place to a fear that outer space and the planets might soon be bristling with red stars, robot tanks and unwinking satellite eyes for Big Brother. Is this fear justified?

Only the sweeping tide of advancing technology will provide an answer to the technical feasibility of such ideas. But even if these plans are brought to maturity they should excite no fear. Our fears of such developments spring from the inherited traditions of political thought which equate control with power and ownership; and power with the desire for domination. There is nothing in these equations which springs solely from the conquest of outer space. There is no evil in a military Earth satellite which did not exist before in an ICBM, an artillery shell, a knife or the hands of a homicidal maniac. These are old sores in human history.

The fatal errors are the equations:—

control = power
power = domination or occupation
domination or occupation = ownership
ownership = the right of autocratic disposition
the right of autocratic disposition = total submission

Statesmen bridge the gap from control to total submission without a second thought. So do generals. No other man is in a position to question the result, and yet all other men are the first to be submerged by the consequences. This is not the time or the place to blame all wars on politicians and soldiers. But it is time to pause for reflection on the brink of the Space Age, and to see whether the future use of outer space is to be helped or hindered by the continued use of mediæval concepts of national sovereignty.

Science and the Law. The laws of mankind are the accretions of generations of human thought and custom, slowly penetrated by scientific ideas. The laws of nature are gradually unfolded by rational men in successive ages. There has always been an abysmal lag between accepted law or morality (which may be known to a multitude) and accepted science, which in the past has been the privilege of a few. Conflicts are perpetual and of varying severity. The roundness of the Earth was once heresy. Even today, certain types of abnormal persons are regarded, with all the majesty of the law, as sane criminals fit only for incarceration or slaughter. Today science and technology have far outstripped the conventions of law. Human artificial insemination poses legal problems of inheritance and marital offences which cannot yet be settled. The physicist's concept of action at a distance has no recognized parallel in law. The legal liabilities of those who conduct rain-making experiments are far from certain. The scope of anarchy and "crime" which may be committed with impunity in an aircraft flying over the high seas is not defined by any law.

And now, on the threshold of space, there is a danger that this new dimension of freedom will be fettered by outworn legal concepts of control and ownership.

The Danger. Public international law was evolved from the custom and good sense of men who could move about on the surface of the land and the sea, indulge in modest mining and building operations and, later on, ascend a few miles into the air. Early ideas of ownership and possession of goods possibly preceded the ideas of national or racial sovereignty. The primitive notions of "might is right" and "occupation is ownership" lie just beneath the surface of international politics even today. United Nations exists because we wish to discard the crude implications of these crude ideas. It fails to solve all the problems which arise because the primeval crudities still exist—aided by the relatively new forces of economic need and industrial potential—and reinforced by the terrifying principle that a State's sovereignty is an impregnable wall not to be breached except by special consent or war.

National sovereignty is an invaluable principle for dividing the surface of the Earth into economic or defence units. It becomes a dangerous disease of the mind when used to stifle individual liberty of thought or when it is used to project nationality from the surface of the Earth up into space itself.

The die was cast in 1919 when, in the aftermath of the first world war, the European nations who joined in the Paris Convention granted to each other exclusive sovereignty in the *airspace* above their respective territories. For the modest heights which could be envisaged for aircraft of the then foreseeable future, this was not unreasonable. But, unfortunately, the same basic idea is now being used to extend the upper limits of sovereignty so as to trap the heedless satellites.

The dangers have been stated by eminent writers[1,2] who have pointed out that international air law "is essentially earthbound and land minded".[2] Equally eminent writers such as Professor J. C. Cooper[3] at one time suggested that national sovereignty should be extended to altitudes at which some control can be exercised—and this obviously involves an expansion of sovereignty with each advance in technology.

There is no body of law dealing with outer space but there has arisen a great deal of legal literature on the subject, with a flimsy background given by international and national reactions after such minor excursions as the flights of high-altitude balloons. The number of articles reflects the progressive lawyer's earnest desire to grapple with the opportunities afforded by science to create a legal system for the virgin space. It is perhaps the legal equivalent of the golden age of empire-building. The scientists have been relatively silent—not realising, perhaps, that their legal colleagues can be indulging in such fantasies as the methods of establishing legal ownership of the Moon.

The unexpected emergence of the first two artificial satellites on the wrong side of the Atlantic has resulted in international discussions for control of such objects being interlinked with disarmament talks in the often angry forum of United Nations. This underlies the lawyer's views that the matter should have been resolved by a peaceful international agreement long ago. Unfortunately it may also persuade scientists and technologists that the political arguments which ensue are none of their business.

Fortunately the satellites now circling have been allowed to do so without official protest from any subjacent nation. As Professor Cooper pointed out in a recent talk to the British Branch of the International Law Association[4], this may be the clearest indication for the future that the space in which the satellites travel is not regarded by any government as being within its sovereignty.

The Present Situation. Those nations which subscribe to the Chicago Convention of 1944 agree to respect each other's sovereignty in the *airspace* over their respective surface possessions. The U.S.S.R. and her terrestrial satellites have not joined this convention, although the U.S.S.R. has adopted a similar mode of describing the aerial extent of her sovereignty.[5] Some writers argue that "airspace" extends high as aerodynamic lift can be generated; others suggest that airspace extends so far as particles of air exist. Only very rarely do legal writers seem to be aware[6] of the scientific difficulties implicit in these ideas.

It is an attractive, rational idea to make the limits of terrestrial jurisdiction and sovereignty coincide with some apparent natural "boundaries" such as the upper "limit" of the atmosphere or of aerodynamic lift.[7] But in the last analysis the limits for jurisdiction will be *arbitrary* limits and it may save a great deal of time and frustration in international discussions if this idea can be accepted as inevitable. For example, the limits of terrestrial sovereignty could be described very simply by the surface of an arbitrary sphere enveloping the Earth.

The cost of expeditions to the Moon and other planets may be an unsuspected source of truly international co-operation (*i.e.*, including Russia)—in which case it is easier to visualise joint codes of conduct for human activities in the solar system. But if such a code of conduct is not achieved on a truly international basis there is no reason why the familiar set of equations should not arise again:

control = power = domination or occupation = ownership, etc.

Anarchy in the solar system is an equally unattractive solution. Moreover, as Haley has pointed out,[1] human beings may not be the only lawyers in space. Another equally eminent international lawyer has said, "It is most desirable that jurisdiction over activities in space beyond the atmosphere should be recognised to be vested in the United Nations and that legislative authority over activities beyond the atmosphere of the Earth should be exercised by the General Assembly acting through or on the advice of an appropriately constituted body."

Some Possibilities for the Future. The scientific co-operation which has created the IGY is capable of development for the needs of satellites and outer space. The machinery which drew up plans for the IGY should be used without delay to draw up a code of conduct for human activities in space. The evolution of a code

THE LAW OF MEDIÆVAL SPACE . . .

should be entirely the work of scientists, assisted by international lawyers for drafting purposes only. Suitable legal assistance would surely come, if requested—perhaps from the legal committee of ICAO, augmented by Russian lawyers so as to draw fully from international resources.[9]

The separate States of the world, in such circumstances, could wisely refrain from participation as *States* and leave the work to the individual scientists selected by their colleagues. The enforcement of the code could safely be left to users of the code in their scientific capacity, but with full support from individual States.

It has needed no legislation to make the IGY possible. It may need none to move safely and peacefully in space.

Meanwhile governments may attempt to agree on an upper limit for the exercise of sovereignty. The way to avoid absurdities is not to *raise* the limits to deal with every possible satellite orbit, but to *lower* the limits so as to exclude all likely orbits, e.g., 100 miles or even lower. In this way it may be possible to liberate the exploration of the universe from the fungus of mediæval space.

Politicians and lawyers may complain that this type of solution only solves political and legal problems by pretending that they do not exist. The example of the IGY is ample evidence that it may only be politicians and lawyers who believe that the problems *do* exist.

Conclusion. To summarize, there seem to be three most urgent problems in need of practical solution. They are listed below in the order in which they can probably be best accomplished—despite the fact that this order may not be desirable from the point of view of legal theory:—

(1) *Establish a code of conduct for human activities in space.* The machinery for drawing up the code should be non-governmental, but international in character, composed primarily of scientists and following the broad pattern set by the organisation for the IGY. The Cooper Committee[9] would be an excellent starting point.

(2) *Establish an international conference to draw up a universal multilateral convention on the arbitrary upper-altitude limit of national sovereignty.* The ideal agency for such a conference would be UNO—with the assistance of ICAO.

(3) *Establish an international conference to draw up a universal multilateral convention on the human occupation and use of the planets and their natural satellites.*

For this purpose it may be necessary for UNO to create a specialized agency. The difficulties are tremendous for, as A. G. Haley is reported to have said, "mankind must mature appreciably to create an international authority having sole and complete jurisdiction over space-flight. No single nation has a paramount claim to outer space."

Bearing in mind the formidable problems which face international agreements generally, it seems desirable not only to tackle the above problems in this order, but to ensure that they are dealt with as *separate* problems and, above all, to divorce them at all times from discussions on the warlike use of space, or on disarmament. No one need be deluded into thinking that any agreement could, by itself, inhibit the warlike uses of space.

Postscript. It may perhaps be too late to tackle the problems in the order, or even in the way suggested above. Recent exchanges between the U.S.S.R.[10] and the U.S.A. suggest that space is likely to become a military playground with scientific results being the incidental fruit of warlike explorations. Each planet has already become a mere pinpoint in the map for planning international strategy in the control of the Earth and, ultimately, the habitable portions of the solar system.

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(2) "International Law and High-altitude Flights" by B. Cheng. 6 International and Comparative Law Quarterly (July 1957).
(3) "High-altitude Flight and National Sovereignty." 4 International Law Quarterly (1951) and "The Times," September 2, 1957.
(4) "Flight," December 6, 1957, page 890.
(5) M. Aaronson, Ibid. and 224 Law Times 220.
(6) See, for example, a clear exposition by B. Cheng in Current Legal Problems (1956), page 214.
(7) "Space Law and Metalaw—Jurisdiction Defined" by A. G. Haley. 24 Journal of Air Law and Commerce 3, page 286.
(8) "International Law and Activities in Space" by C. W. Jenks. 5 International and Comparative Law Quarterly 99 (1956).
(9) Since this article was first written it has been announced ("Flight," October 25, 1957, page 659) that at the Eighth International Astronautical Federation Congress at Barcelona it was agreed to appoint a committee to define *the separate jurisdictions of air law and space law* and to submit a resolution to the Secretaries-General of UNO and ICAO. The committee is to consist of four scientists and three lawyers. The U.S.S.R. is invited to nominate two members and it is probable that U.S.A. participation will also be two. The first chairman of the committee is Prof. Cooper.
(10) Point No. 1 in the recent Soviet four-point peace plan is "Prohibition of the use of outer space for military purposes, and an undertaking by States to launch rockets only in accordance with an agreed international programme." "The Times," March 17, 1958.

FRENCH SLOW FLYER

Details of the Nord-Aviation 3400

THE Nord 3400, which made its first flight—in the hands of André Turcat—on January 20, has been passed to the C.E.V., Brétigny, for its official acceptance trials. Design was to a 1956 specification issued by l'Aviation Légère de l'Armée de Terre for an observation aeroplane; all other projects had been eliminated by January 11, 1957; the final mock-up conference was held five weeks later; and work then began within two weeks.

The Nord 3400 bears some slight resemblance to the NC-856, but is generally a much cleaner aircraft. The engine is a 240 h.p. Potez 4-D 30 inverted six-cylinder in-line, fitted with a Ratier 23-92 hydraulic variable-pitch propeller.

Wing structure is metal, with a single spar braced by single struts from the fuselage, and is fabric-covered apart from the leading-edge D-skin and the tank bays near the root. Two flexible fuel-cells, of 24 gal capacity each, are mounted in the wing roots behind the spar. Production aircraft will have folding wings which will pivot around the main root fitting after uncoupling of the struts and the flying controls. Flaps and ailerons are metal framed and fabric-covered. The former are of the double-slotted type and appear to have a maximum deflection of about 45 deg.

The large high-aspect-ratio tail unit is metal framed and fabric-covered. The tailplane is fixed, trim being achieved by an elevator tab. Cantilever main legs, with oleo-pneumatic shock-absorbers in the fuselage and a castoring tailwheel, form the landing gear.

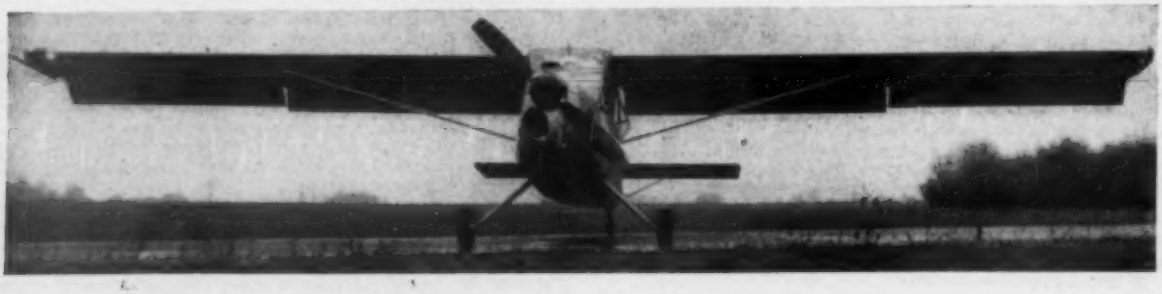
Fuselage structure is of welded steel tubes, the front part being covered by light-alloy panels and the rear with fabric over wooden former-frames. The large plastic cabin area overhangs the fuselage proper to give a good downward view. The crew of two is seated in tandem, with dual flying controls; the rear seat is rotatable through 360 deg. There are separate doors for pilot and observer in the starboard side, with a long stretcher door in the port side. Full blind-flying instruments and lighting equipment are fitted, together with electrical intercom and both V.H.F. and H.F. radio. The flaps are lowered hydraulically by a hand pump at the front seat. In addition to the observation and *sanitaire* rôles, the aircraft can be fitted for photography, with light bomb racks, armour, or catapulting gear.

NORD 3400 (POTEZ 4-D 30)

Geometrical data: Span, 41ft 8in; length, 27ft 8in; height, 10ft 3in; tailplane span, 11ft 10in; track, 7ft 3in; fuselage width (at seats), 2ft 10in; wing area, 210 sq ft; aerofoil section, NACA 23015.

Weights: Empty, equipped, 2,028 lb; fuel, 353 lb; crew, 397 lb; disposable load, 198 lb; maximum gross, 2,976 lb (2,866 lb for observation mission).

Performance (estimated): Maximum speed, 124 m.p.h.; minimum speed, 44 m.p.h.; take-off and landing runs, about 100 yd; initial climb, 1,400ft/min; range, 621 miles.



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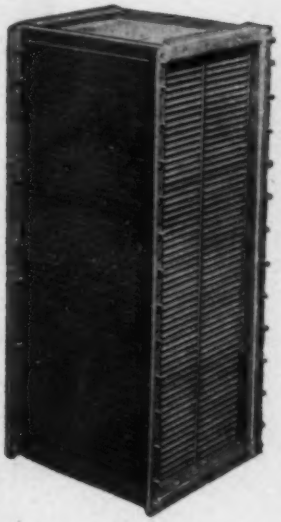

We design, manufacture and supply heat exchangers for many purposes in both aluminium alloy and stainless steel. This particular example is for the Vickers Viscount's anti-icing system. Similar units are supplied for the Fokker Friendship and the Bristol Britannia.

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I.A.C. Report Viscount Success

Having introduced Viscounts into service on October 10, 1957, Indian Airlines Corporation have this to say: 'Evidence of the popularity of the Viscount and a compliment to its passenger appeal is revealed by the fact that up to December 31, 1957, some 16,242 passengers had flown in I.A.C. Viscounts. Ever since the first Viscount was put into service on the Delhi-Calcutta-Rangoon route there has been a steady climb in passenger figures. This progressive trend has been noticeable on the other routes on which Viscounts were subsequently introduced.'

The maintenance man's problems have always been very much in the minds of the Viscount design team. Advances made in the aircraft during its continuous evolution have resulted from operational needs and from discussion with the men responsible for keeping the Viscounts at the peak of performance. Viscounts are now backed by the ten years' propeller-turbine experience of Vickers and Rolls-Royce. In the latest version — the Viscount 810/840 — this means an aircraft that is more accessible for maintenance, easier to memorise, cleaner to work on and more rapidly serviced. Result — faster turnround, lower overheads and aeroplanes where they should be — in the air and earning profits.

There is no substitute for experience

VICKERS - ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY
TGA AT723C

Emerging last week from the Fokker factory at Schiphol, is the first production Friendship—one of seven ordered by Aer Lingus. Roll-out of the first Fairchild-built F.27 Friendship (for West Coast Air Lines) is imminent.

CIVIL AVIATION

LONDON - MOSCOW - DELHI

REPORTS from New Delhi suggest that services between Moscow and Delhi might start early in May. The precise date for inaugurating London - Moscow services has not yet been announced, although operations should begin "by September at the latest." When both sectors of this new route between the U.K. and India are connected, it may be possible to fly from London to Delhi in an Aeroflot Tu-104, or by B.E.A. Viscount and Air-India L.1049G. Journey-time for a passenger using the Tu-104 has been given as 17 hours. This seems an unambitious programme for the Russian jet, which should—allowing 45-minute transit times at Tashkent, Moscow and Copenhagen—cover the distance comfortably in 12-13 hours. The fastest service through the Middle East takes 22 hours (of which four are on the ground).

The potential time-saving on the Tu-104 service is a reflection of this aircraft's higher cruising speed; for the route to Delhi via Moscow and Tashkent is slightly longer than that via the Middle East. This alone will justify a higher fare on the Russian route.

DEUX PONTS IN AMERICA

"A SUCCESSFUL and promising trip" was the French summing-up of the 25,000-mile, 127-hour tour through North and South America by F-BASQ, the Bréguet 765 Deux Ponts. The aircraft was shown to airline personnel in New York and Washington, to "eleven air transport companies" at Miami and Havana, Bogota, Lima, Santiago and Rio de Janeiro. High spots of the trip were a wide press coverage in New York, participation in an international air display at Miami and demonstrations from the short Santos-Dumont airfield after the Brazilian authorities had insisted that Galeao Airport should first be used.

While the Deux Ponts was in Washington, it was assessed by the A.T.A. on formula costs per ton-mile. Over a 1,000-mile stage this was calculated to be 7.9 cents—better, Bréguet claims, than any existing twin-engined aircraft and better also than the DC-4 or DC-6. The A.T.A. representative is reported as saying that the calculated costs do not reflect the Deux Pont's operational flexibility—particularly the ability to load both decks simultaneously.

NON-FLYING DUTCHMAN

K.L.M. pilots returned to work on Thursday of last week after a four-day strike which had reduced the airline's operations to a few flights daily using non-union pilots.

The immediate cause of the strike was the dismissal of two pilots on the grounds that they had published critical statements about their company's recent dismissal of three other pilots. This strike came at an embarrassing moment for the K.L.M. management. The uprising in Indonesia meant that about 140 aircrew who had been seconded to Garuda Indonesian Airways had to be absorbed at a time when the company's rate of growth was slowing down. Complicating the situation further, the unions chose this moment to press for an eight per cent increase in salaries. At the time of the strike K.L.M. management had responded with a counter-offer of 7.5 per cent.

Effects of the strike were felt outside the Netherlands. B.E.A. were prevailed upon not to run extra flights to Amsterdam, while a group of Swedish pilots sought an I.F.A.L.P.A. boycott on services to the Netherlands.

The strike ended with the pilots' organization apologizing for having "created a wrong impression"—the misunderstanding being ascribed to the use of English—and by the company reinstating the two dismissed pilots.

The cost of the strike must be considerably less than the widely reported figure of £500,000-£600,000. This is based on current average weekly revenue of K.L.M. The fact that traffic carried in mid-March is rather below the average, coupled with the saving in operating costs, should reduce the real loss to only about half the amount quoted.

CAPTAIN G. P. OLLEY

WE regret to record that Capt. Gordon P. Olley, M.M., A.R.Ae.S.—known affectionately in aviation circles as "G.P.O."—died in Wimbledon Hospital, London, on March 18 at the age of 64.

He had done over 13,000 hours' flying as pilot (in 1931 he became the first to have flown a million miles, and three years later published a book, *A Million Miles in the Air*) and there was not one casualty among the 40,000 passengers he carried.

He served as a pilot in the R.F.C. (destroying 13 enemy aircraft) and after the war joined Handley Page Transport, Ltd., flying on the first Continental air services. In 1921 he inaugurated the London - Amsterdam route for K.L.M. and three years later he joined Imperial Airways. He started the Silver Wing service from London to Paris in 1927 and continued as chief pilot until he resigned in 1934 to start his own company, Olley Air Service, Ltd.

"G.P.O." held every licence available to a pilot; as long ago as 1922 he set up a duration record in a glider; and in addition to being managing director of Olley Air Service he was a member of the council of the A.R.B. and founder-member and treasurer of the British Air Charter Association.

Bréguet's Deux Ponts (see paragraph above) at Santos Dumont, Rio de Janeiro, with the famous Sugar Loaf in the background. From Rio the aircraft flew to Brasilia, the future capital of Brazil, 600 miles inland.

CIVIL AVIATION . . .

The Lockheed Jetstar seen recently on its first visit to Lockheed's plant at Marietta, Georgia, where it will be produced if the U.S.A.F. places an order. The Bristol Orpheus-powered jet had flown from Burbank in 3½ hours. Its competitor is the McDonnell 246 project.

DISCUSSING ROUTE CHARGES

DELEGATES from some 25 nations and international organizations have now been conferring in Montreal's Aviation Terminal Building for over a week on the subject of charging fees for air-route facilities. Operators are at present only occasionally asked to pay for these services, governments normally including the costs with the other expenses of running airports.

The cost of providing *en route* facilities is mounting steadily as traffic density increases and as the needs of high-speed, high-flying turbine aircraft are becoming known. Airport authorities, especially in the case of those lesser airfields which are overflown by a large number of aircraft, are reluctant to raise landing fees to cover this expense, particularly when such an increase results in airlines transferring to airports that are less cost conscious.

Certain *en route* facilities—communications, traffic control and meteorological services—can sensibly be charged on a user basis. The expense of navigational aids (which often do not require direct contact with the aircraft involved), of emergency landing fields and of search and rescue services is less easily allocated. In those cases where provision of these services causes hardship there is a strong case for an extension of the joint financing system so successfully developed by I.C.A.O. for North Atlantic navigational facilities.

BREAKING THE SILENCE

IN recent months the C.A.B. has been faced with a mounting wave of protest, suggesting that the Board was out of touch with the needs of the U.S. air transport industry. Typical of the airline's attitude was the hostile comment uttered by Mr. Stuart Tipton, president of the Air Transport Association, when the C.A.B. authorized an interim fare increase: "the C.A.B. has evaded its responsibilities. . . ." The latest outcry was voiced by the influential journal *Life*, an editorial being devoted to an attack on the bureaucratic attitude adopted by the C.A.B.

This appears to have touched a sore spot. At a Press conference called to explain their refusal to eliminate procedural steps in the General Passenger Fare Investigation, the Board's chief information officer, Mr. William Kloepfer, Jr., circulated a letter denying that "the C.A.B. is dragging its bureaucratic feet while the financial structure of the country's airlines is going to pot."

Mr. Kloepfer stressed that the Board was aware of the need for airlines "to cope with rising costs and the acquisition of jet aircraft," and reminded his readers that the recent fare increase demonstrated that the C.A.B. was not delaying necessary decisions until the General Passenger Fare Investigation was concluded. He emphasized that their object was to "support the rights of all the parties in this investigation to a fair hearing . . . and to guarantee the public and the industry the full measure of their rights in this most important examination of the fare question in the history of American commercial aviation."

These statements strike right home at the fundamental question which the Board's traducers have chosen to ignore: what are the needs, not of the airlines, but of the community? Possibly the most remarkable feature of the last 18 months' attack on the C.A.B. has been silence on the part of the general public. That this body of opinion is seldom vocal on matters to do with air transport was shown by its failure to respond to the disbandment last year of the consortium of low-fare non-certificated carriers. Public objection to high air fares appears to be expressed not directly through such instruments as Congress but indirectly by the greater use of motor-cars, and by an alacrity to forego air transport when times are less prosperous. The post-Korean recession in the U.S. hit domestic air traffic sharply. The present hesitations in the economy, combined with newly increased fares, had the effect of reducing the growth of U.S. domestic passenger-miles last month to less than two per cent over the figure for the previous February.

This passive resistance on the part of the public compares with the noisy, and often abusive, attack on the C.A.B. which has emanated primarily from four groups: first, airlines which believe that a fare increase is necessary to finance purchase of the turbine aircraft already ordered; second, manufacturers who are concerned at the absence of new orders, or, even worse, cancellation or postponement of existing orders; third, financial institutions that agreed to make loans available to airlines at interest rates well above those now obtaining; fourth, shareholders and their brokers who are faced with an embarrassing deterioration in the value of airline shares. All these groups believe they stand to gain from an increase in fares. The problem for the C.A.B. is to decide whether these groups are their own best advocates: if higher fares led to traffic increasing at a slower rate than capacity, then the airlines' position would be jeopardized rather than enhanced. If the C.A.B. agree that the case for higher fares is well based, the question remains whether such a change would be in the public interest. If there is a need for hurrying a decision on these highly complex problems it is the fault not of the C.A.B. but of the airlines.

APPEALING TO THE HESITANT

BRITISH travel agents are concerned about the coming summer's tourist trade. Despite an intensive promotion campaign that was under way before the Old Year was out, and contrary to the hopes that were raised by the inflow of many general inquiries about travel facilities, customers are still not coming forward and committing themselves and their families. The reason for this hesitancy is clearly evident: many people are uncertain as to how much money they will have available for spending on their annual holiday.

No moment could be more propitious for offering really cheap air travel. This opportunity has been seized by Air Charter, Ltd., to announce a new coach-air service using Bristol 170s that will link Southend with Ostend, Rotterdam and Calais. Return fares (including the coach journey from Euston Square to Southend airport) will be £6 17s to Calais, £7 7s to Ostend and £10 14s to Rotterdam.

Now being used for crew-conversion training at Vickers' airfield at Wisley is the first of five Viscount 794s ordered by Turkish Airlines (T.H.Y. Turk Hava Yollari). The picture shows the aft section of the cabin, which is sumptuously furnished for executive use. It is convertible to normal passenger seating, in which rôle—together with the other four T.H.Y. aircraft—it will serve Turkish domestic routes, starting in the summer.

C.A.A.C. VIKING ACCIDENT SEQUEL

A CLAIM against Vickers-Armstrongs (Aircraft), Ltd., by Central African Airways is being heard in the Southern Rhodesian High Court at Salisbury by Mr. Justice Hathorn. The airline is claiming damages of £216,000 in connection with the accident to one of its Vikings on March 29, 1953, when five crew and eight passengers were killed, following a structural failure.

The cause was established at the time as fatigue of the starboard main spar, which had been weakened by corrosion following the use of D.T.D.577 grease on unplated wing-joint pins. It is upon the treatment of these components that C.A.A. are basing their case.

Mr. I. A. Maisels, appearing for C.A.A., said that Vickers' case had been, up to now, that the omission of cadmium plating of the bolts was deliberate. There was no suggestion that it had been omitted by accident. He said: "Central African Airways will submit that, even if that is the case, there was negligence in the construction of the aircraft." Mr. Maisels added that drawings relating to specifications, which had been received for the first time from Vickers in February, showed that it had always been intended to have the bolts cadmium-plated.

Such plating, he continued, was mandatory for bolts of that kind when a Class 1 finish was specified. It was clear that the fit of the bolts was not so tight as to make the plating impracticable. Vickers had examined hundreds of bolts from wing joints of time-expired Vikings and had found corrosion in all cases where the bolts had not been plated. Of 150 bolts examined about one-third had been cadmium-plated. The failure to plate the remaining two-thirds was due to an error; it was obvious that the wing joint in question was more liable to penetration by moisture than most joints.

It appeared that a jointing compound was used, and was expected to give complete protection for a period of between 10 and 20 years. As long ago as 1946 that method of construction was improper, as corrosion was inevitable, concluded Mr. Maisels.

The case is expected to last at least a month.

RUSSIANS BREAK THE ICE

A CORRESPONDENT lately in Moscow sends *Flight* this account of how the airport authorities there are organized to deal with ice and snow:—

"The ice and snow clearance equipment was certainly impressive. A large roller, about four feet high and some five feet wide, is studded with massive iron spikes about five inches high. This is towed over the ice and breaks it up by a cracking process. The next vehicle on the scene is a large lorry with an enormous fuel tank on the back and a downward-pointing jet engine on the front. This moves up to the cracked ice with the jet running. Chunks of frozen ice are then blasted off the concrete; their almost lethal range is about 50ft. The heat from the jet then melts any ice that is left and the runway is rapidly dried.

"For simple snow-clearance they use ploughs, graders and a particular type of plough that blows the snow up through a pipe (in the fashion of a grain loader) and discharges it into a lorry that waits under the outfall and moves alongside in formation with the plough. As soon as the lorry is full the plough stops until another lorry comes alongside. As there is usually a queue of six lorries waiting nose to tail behind the plough there is little or no delay. The lorries have high sides and contain about 5 cu yd, or perhaps a little more.

"This work goes on non-stop throughout the twenty-four hours. Only the runways and aprons are kept permanently clear. Up to six inches of snow on the taxiways is tolerated. The runway lights are a sample of ingenuity. They are mounted on retractable stalks of about 14in to 18in. When the snow falls they are pulled up to their full extent and kept clear of snow. In the summer they are pushed down again to lie flush with the ground."

On the left is Mr. P. J. Brennan, whose appointment as the head of Aer Lingus' commercial division is announced. He succeeds Mr. Max Stuart-Shaw, recently appointed general manager of Central African Airways. On the right is Mr. W. H. Lyons, PanAm's new traffic sales manager in the U.K. He succeeds Mr. James Leet, who is taking up a new post with PanAm.

PASSENGER MANIFEST OVERBOARD

THE anti-red-tape campaign which I.A.T.A. ceaselessly wages has met with further success. The passenger manifest—the list of passengers required by governments for most international departures—has now been eliminated by 13 European countries for intra-European flights. I.A.T.A., however, say (without mentioning names) that there are still some European governments which demand this "needless duplication of information available to government authorities from the other forms which they require."

The U.S.A. and Canada have abolished the manifest requirement but, says I.A.T.A., elimination of the manifest is only one step in the right direction: "Unless solutions to [terminal delays] can be reached, the jet age will lose much to the frustration of forms and formalities that beset air passengers and air cargo."

BREVITIES

ACCORDING to *Aviation Daily*, PanAm plan to fly a 707 to Europe in August. First service may be on November 1.

* * *

Hunting-Clan have applied for permission to operate a scheduled cargo route between Johannesburg and London. Their present services terminate at Salisbury.

* * *

Continental Air Lines, who are soon to take delivery of Viscount 810s (which they are calling Viscount 2s), have been using Vickers' Viscount 745 demonstrator for Denver-based crew-training.

* * *

Trans Caribbean Airways have been admitted to associate membership of I.A.T.A. Trans Caribbean, with head office in New York City, operate scheduled services between New York and San Juan, Puerto Rico. They have one DC-8 on order. The company's admission brings to 82 the number of I.A.T.A. airlines.

S.A.S. announce a third weekly flight on its trans-polar DC-7C service between Copenhagen and Tokyo via Anchorage.

* * *

Overhaul life of the P. and W. J57, powerplant of the domestic versions of the 707 and DC-8, has been approved by the U.S.A.F. —though not by the C.A.A.—for 1,000 hours.

* * *

A contract worth $4½m has been awarded to General Precision Laboratory by the U.S. Airways Modernisation Board, for the design of a semi-automatic traffic control data-processing system.

* * *

Flight records with regret the death of Capt. G. S. Brown, B.O.A.C.'s inspector of accidents, at the age of 60. A famous pioneer commercial pilot with an accident-free record, he joined Imperial Airways in 1935, and was an active airline pilot until 1949.

* * *

Representatives of about 40 airlines, and delegates from engine manufacturers, attended a conference on airline turbine-maintenance and testing at Zurich from March 19 to 21. Chairman was Mr. Guy Westermann of Swissair.

* * *

B.O.A.C. have "no immediate plans" for a trans-polar service to the Far East, stated the Minister of Transport in the Commons last week. They were, he said, intending to open the South American services to Brazil, Uruguay, Argentina and Chile, but probably not until 1959. "Initial losses" might be incurred.

Seen boarding a PanAm DC-6A for shipment to PacAero of Santa Monica, California, is a Napier Eland turboprop, destined for installation in the Convair 440 bought by Napier to further their turboprop-conversion programme. As reported last week, the Eland engine has now passed its official type-test under A.R.B. and C.A.A. conditions.

SERVICE AVIATION

Royal Air Force and Naval Flying News

Crews of Bristol Brigand T.5s of No. 238 O.C.U., which was recently disbanded at R.A.F. North Luffenham, leaving their aircraft after a final formation fly-past (an air-to-air picture is published on p. 409). The Brigands are eventually to be ferried to an M.U. for disposal.

40th Anniversary Broadcasts

WHEN the Queen and the Duke of Edinburgh dine on April 1 at Fighter Command headquarters, on the R.A.F.'s 40th anniversary, speeches by Her Majesty and the Secretary of State for Air will be broadcast in the B.B.C. Home Service, and the dinner is also to be televised by the B.B.C. The next evening a B.B.C. feature on the R.A.F., *The First of the Many*, is to be broadcast in the Home Service, and will be introduced by Air Chief Marshal Sir Philip Joubert and many distinguished early members of the R.A.F.—all ex-members of the R.F.C. and R.N.A.S.—are taking part. Those participating are to include Marshal of the R.A.F. Sir John Slessor, Lord Brabazon of Tara, Air Chief Marshal Sir Arthur Longmore, Air Chief Marshal Sir Robert Saundby, G/C. Ira Jones, G/C. F. C. V. Laws, Lt-Col. L. A. strange, and W/C. R. H. McIntosh.

More Flying for A.T.C. Cadets

SPEAKING in the House of Commons on March 10, the Secretary of State for Air, Mr. George Ward, announced an increase in flying and gliding activity for cadets of the Air Training Corps and Combined Cadet Force.

A new air-experience scheme will utilize 50 Chipmunks which will replace the ten Ansons at present used for this work. The Chipmunks will be based at the 17 University Air Squadrons and cadets will be flown at weekends and at annual camps. Pilots for the Chipmunks are to come from the R.A.F.V.R. (Training Branch)—volunteers to this branch from ex-R.A.F. and ex-Auxiliary pilots are being recruited—and will be assisted by U.A.S. instructors.

The expansion in gliding activity will include the opening of a second full-time gliding centre (in addition to the existing centre at R.A.F. Hawkinge), probably located at R.A.F. Spitalgate. Six additional weekend gliding schools will increase the total number to 26, and should enable the number of cadets trained to B Certificate standard each year to be increased from 1,600 to 2,400.

Within a few hours of Mr. Ward's statement in the House, many requests for enrolment as Chipmunk pilots in the R.A.F.V.R. had been received at Home Command Headquarters. Approximately 150 pilots will be needed, and selection is expected to start soon.

Christmas Island Awards

AWARDED the B.E.M. for gallantry, Acting Cpl. J. M. Etherington, R.A.F., in August last year saved the lives of two out of four soldiers who had been swept beyond the coral reef when bathing off Christmas Island. Queen's Commendations for Brave Conduct—under similar circumstances—go to L. A/C. T. J. Scott and A/C. J. A. Kay.

R.A.F. Postings

AMONG appointments recently announced by Air Ministry are the following:—

G/C. G. C. Godfrey to H.Q., Allied Air Forces Northern Europe, for staff duties; Acting G/C. L. T. Card to Air Ministry, for duty in the Department of the C.A.S.

W/C.s A. D. Adams to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; P. G. Brodie to R.A.F. Rufforth, as President of No. 2 Standing Court Martial; I. G. H. Drummond to No. 14 Maintenance Unit, Carlisle, for administrative duties; R. J. Kelsey to H.Q., Flying Training Command, for planning staff duties; S. McCreith to M.o.S., Bedford, as O.C. flying and unit commander; F. T. Solis to H.M. Transport *Devonshire* as O.C. troops; G. T. Thain to R.A.F. Lyneham, Wilts, for flying duties; R. A. Barton to Air Ministry, for duty in the Department of the Chief of the Air Staff; T. N. N. Brennan to H.Q., No. 23 Group, Flying Training Command, as Senior Medical Officer; L. J. Joel to Air Ministry, for duty in the Department of the Chief of the Air Staff; K. F. Mackie to R.A.F. Gutersloh, 2nd T.A.F., as officer in charge of administration; K. G. Major to H.Q., Home Command, for staff duties; J. M. Morgan to the School of Land-Air Warfare, for liaison duties with Southern Army Command; E. B. Panter to the NATO Defence College; J. H. G. Sarll to R.A.F. Stoke Heath, for administrative duties; C. K. Saxelby to Air Ministry, for duty in the Department of the Chief of the Air Staff; A. T. Staveley to R.A.F. Greenham Common, to command, and for liaison duties with the U.S.A.F.; G. E. Tweddle to Air Ministry, for duty in the Department of the C.A.S.

S/L.s S. A. Bunting to H.Q., No. 13 (Fighter) Group, for logistics staff duties (with acting rank of wing commander); N. S. Fear to R.A.F. Medmenham, Bucks, to command (with acting rank of wing commander); P. W. Lovell to R.A.F. Odiham, Hants, as O.C. Flying Wing (with acting rank of wing commander).

No. 2 Group Reunion

ON May 3 the No. 2 Group Officers Association (H.Q. and Units) is holding its 11th A.G.M. and Reunion Dinner. Details can be obtained from the Secretary, 205 Eastgate, Louth, Lincs.

IN BRIEF

Air Marshal Sir Hubert Patch, C-in-C. M.E.A.F., recently paid a four-day visit to the Pakistan Air Force.

* * * * *

The R.C.A.F. has completed its official evaluation of the Canadair Argus and deliveries to Maritime Air Command are due to begin in April.

* * * * *

The R.A.A.F. College at Point Cook, near Melbourne, celebrated its tenth birthday last month. Since its establishment in 1948, 113 cadets have graduated, including five from the R.N.Z.A.F. and three from the Pakistan Air Force.

Seeing things for themselves on recent official visits are (below, left) Air Marshal C. E. Chilton, A.O.C. Malta and Deputy C-in-C. (Air) AFMed, with the Italian C.A.S., Gen. S. Napoli, at the Ministero Difesa-Aeronautica in Rome; (centre) Lord Selkirk, First Lord of the Admiralty, with Admiral Sir William Davis, C-in-C. Home Fleet, on his right and Capt. P. Grick, commander of H.M.S. "Bulwark," on his left during the Anglo-Canadian Exercise "Maple Royal"; (right) Air Commandant M. H. Barnett with W.R.A.F. policewomen in Nicosia on her visit to M.E.A.F.

CLUB AND GLIDING NEWS

THIS week-end is expected to be the last during which members of the Yorkshire Aeroplane Club will be flying from their base at Sherburn-in-Elmet. The club, due to close down on Sunday, March 30, gives the following reasons in a circular to members. Firstly, the falling-off in membership to the uneconomic figure of approximately 130, which is only one-half of the total for 1954. Secondly, the difficulty in finding skilled staff and attracting them to Sherburn. Thirdly, repeated trading losses in each of the past twelve years.

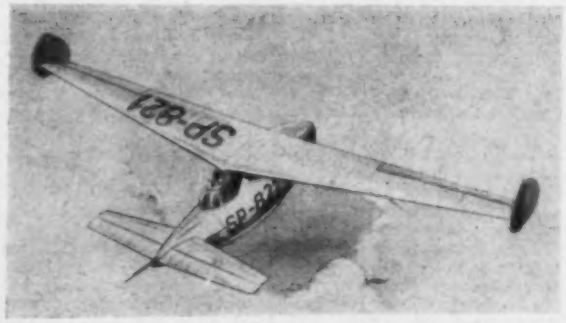
PILOTS from all flying clubs are invited to attend this year's Swansea air display on June 7. Organized in aid of the British Empire Games appeal, this event will be supported by the Tiger Club and the British Parachute Club. Flying demonstrations by Rollason's Arrow Active (if ready in time), the Druine Turbulent, and the Thruxton Jackaroo are planned. Ground attractions such as a barbecue, car race, gym display and dancing on the green are also included on the programme.

AT the 30th annual general meeting of the Northamptonshire Aero Club recently, the chairman, Alderman C. M. Newton, reported that well over 1,000 hours had been flown during the last year. No fewer than 70 club members had achieved their first solo flights, and 14 P.P.L.s had been obtained. The Championship Cup, awarded to the most outstanding flying member, had been won by Charles Boddington, who had also won the De Havilland Trophy at the Tiger Club Aerobatic Contest, Sywell. Among the other competition winners were A. C. Edmonds (best student pilot); J. Beaty (circuit contest); K. E. Corbett (navigation) and D. W. N. Carter (general flying).

TWO Tiger Moths, an Auster 5, Proctor, Aiglet and Monarch form the current fleet of the Cambridge Private Flying Group. At the Group's fourth annual general meeting recently the C.F.I., Mr. W. F. A. Ison, reported that 1957 had been a generally successful year. The two Tigers had logged over 600 hours, and the fleet total was 833 hours. Thirteen members had flown solo for the first time and three private licences had been obtained. In the Masefield Trophy competition organized by the Popular Flying Association, the group had achieved second place, and at the 1957 P.F.A. rally had gained third place. The committee for the coming year consists of Capt. A. C. Taylor, president; J. T. R. Taylor, chairman; D. Hancock, secretary; D. Jackson, treasurer; A. Jarman; P. Firman and A. Moseling. The C.F.I. and the two other instructors, D. Cash and N. F. Whisler, continue as *ex officio* members of the committee.

THE TIGER CLUB combined aerobatic practice with a social call on the Oxford Aeroplane Club during a brief visit to Kidlington on Sunday last, March 23. The Oxford Club has decided to hold a spot-landing competition during April and to present a tankard to the winner.

THE Long Mynd site of the Midland Gliding Club will be the scene of a task-flying rally during the Easter week-end, April 4-8. Competing pilots must have a C Certificate and have completed at least two legs of the Silver C, and the daily tasks will be based on those set at last year's national championships. A handicapping system will be employed in which strutted aircraft will receive a 30-per-cent bonus. Good Friday and the following Tuesday will be optional contest days, and the results determining the winner of the Mynd Cup will be calculated on a daily average.



Designed and built by the Polish Gliding Research Institute, this tail-first glider is known as Kaczka (The Duck).

Auster 3 G-AHLI, newly acquired by the Vickers Flying School (see news item below), seen with the only other Auster 3 on the British Register, now owned by Supermarine test pilot J. W. C. Judge.

ONE of the two Auster 3s on the British Civil Register, both of which have been used by the Vickers group of companies for communications work since the end of the war, has been transferred to the Vickers Flying School. This machine, G-AHLI, has a two-seater layout at present, but it is planned to convert it into a three-seater next autumn. Total flying time logged by the school's 20 members up to the end of last month amounted to 441 hours. Fifteen first solos have been achieved and seven Private Pilots Licences obtained. A tea patrol is planned for Saturday, April 12, when the school will defend White Waltham against aircraft from the other three Vickers clubs.

FAIR OAKS Aero Club have inaugurated a course for the Commercial Pilots Licence, ground training being given in accordance with the approved C.P.L. syllabus by the club's own instructors. A total of 150 hours' flying is provided, consisting of 70 hours in Tiger Moths, 30 hours in Austers and 50 hours in Chipmunks. Ten hours' night flying is included, together with 531 hours of lectures. The first C.P.L. course at Fair Oaks began last month and is to be of 36 weeks' duration. A special club flight to Antwerp is being organized for the Whitsun week-end, May 24-26.

FOR the benefit of pilots attending the International Rally organized by the Channel Islands Aero Club on May 9, arrangements have been made for an escorted flight from Eastleigh Airport, Southampton, direct to Jersey. Escort aircraft will be provided by the R.A.F., and the flight is being organized by the Hampshire Aeroplane Club. The estimated time of departure from Eastleigh is 2 p.m.; those interested in participating should contact Mr. V. H. Bellamy, secretary of the Hampshire club, at Eastleigh Airport.

TWIN-ENGINE conversion training is again being provided by Elstree Flying Club who, in co-operation with the North Middlesex Flying Group, are to operate Gemini G-AIIF. Flying rates for the Gemini will be £8 and £9 (night) per hour. Other aircraft at present available for Elstree members are three Chipmunks, three Hawks and two Autocrats.

THE first issue of *Camphill News*, newsletter of the Derbyshire and Lancashire Gliding Club, was recently produced by an editorial committee of the club headed by Walter Neumark. Its report of club activities for 1957 includes the following statistics: total launches, 4,610; flying time, 1,242 hours; and cross-country distance, 2,065 miles. The club fleet during the year has included one Skylark 2, one Olympia, two Prefects, two Eons, two Tutors, one T.31 and one T.21. Summer gliding camps at Camphill will be held on the following dates: June 30-July 5, July 7-12, July 14-19, July 21-26, August 18-23 and August 25-30.

A BRIEF history of the Bristol Gliding Club is included in the club's recently published official handbook. Flying from the club site at Nympsfield, Peter Scott used his T.42B *Sea Eagle* to take him to Shrivenham, 30 miles away, for a lecture engagement on March 6—arriving at his destination with 4,500ft in hand. Recent flying at Nympsfield has included 70 hours' soaring by members of the R.A.F. Gliding and Soaring Association who brought three sailplanes to the site for a one-week camp.

THE INDUSTRY

Helicopter Computations

AN I.B.M. 650 computer has been used by Westland Aircraft, Ltd., to simulate the flight of a helicopter still in the design stage. So far, two problems have been examined—take-off, and landing after power failure. It is stated that work which has been carried out at the data-processing centre of I.B.M. United Kingdom, Ltd., has shown that what might have been inferred from pilots' reactions to be operating characteristics are in fact characteristics induced by the pilots themselves; and these comparisons between pilots' experience and computer results have enabled improvements to be made in flying techniques. Other computer programmes are now being used in this development work, and more are in preparation.

Dowty Directorship

Mr. H. S. Butt, who has been appointed to the Board of Dowty Equipment, Ltd., as production director, joined the company in 1949 as production manager after having been with the Bristol Aeroplane Co., Ltd., continuously since his apprenticeship days (in 1939 he inaugurated and managed their shadow factory at Weston-super-Mare, which built Beaufighters and afterwards aluminium houses). He was made O.B.E. in 1948 for his services to industry.

Electro-Hydraulics Prizegiving

AT the Electro-Hydraulics, Ltd., apprentice prize distribution, held recently at Warrington, Mr. C. W. Sharp (chairman) said that the company had had to defer for the time being—owing to the credit squeeze—its proposal to build a new apprentices' school; but this scheme would be put in hand as early as possible.

The apprentice supervisor, Mr. J. Lancaster, reported that from July 1956 to June last year the average number of apprentices had been 93 indentured and 13 probationary; and the overall percentage results in mechanical engineering and general workshop courses taken by the boys had been 77.69 per cent.

Mr. H. E. Kemp, works manager of British Railways at Earlestown, presented the prizes and in his remarks as guest speaker said he had listened to "a most excellent record of successes" gained by the company's apprentices.

Controlled Conditioning

WHAT must be one of the most unorthodox factory buildings in the United Kingdom has been completed by Richard Costain, Ltd., at an inclusive cost of £300,000, for Semiconductors, Ltd., at Swindon, Wiltshire. The building is almost completely windowless.

Semiconductors, Ltd., was formed by the Plessey Co. and the American Philco Corporation in May last year to manufacture high-frequency silicon and germanium transitors in this country.

Very stringent working conditions are necessary for this type of work—humidity and ambient temperature must be closely controlled, and the atmosphere must be dust-free. To meet these requirements the 40,000 sq ft factory is insulated, an air-conditioning plant controlling the temperature to ±2 deg F and humidity to ±5 per cent. Ambient dust is reduced by electrostatic and mechanical filtration to less than one cubic micron per cubic centimetre of air. The walls have a specially smooth finish which will not collect dust, and all services are brought up through the floor to avoid the necessity of overhead pipes. Facilities are provided for supplying extremely pure water of 18 million ohms/cm resistivity.

Electro-chemical techniques developed in the United States by the Philco Corporation will be employed, and production equipment valued at over £100,000 has been flown in from America. It is expected that the plant will be in operation by the middle of this year. Administrative and sales staffs from the company's Ilford factory have already moved in.

Study in straight lines: the transducer factory at Swindon, constructed for Semiconductors, Ltd. (see news-item above).

Brown-Bosch Agreement

AN agreement concluded between S. G. Brown, Ltd., of Watford, and the American concern, the Bosch Arma Corporation, will enable the British company to take advantage of technical achievements by the corporation in the development of gyroscopic equipment based on flotation principles, the application of which S. G. Brown have been for some time examining in the light of future land, sea and air navigational developments. The agreement will make available the vast scientific and research facilities of one of the leading American concerns in this field.

IN BRIEF

Mr. Donald L. Forbes, F.C.A., J.P., of Forbes and Co., chartered accountants, has been appointed a director of the Graviner Manufacturing Co., Ltd., with whom he has been actively associated since 1936. He is a Freeman of the City of London and has many local interests and activities in the East London area.

* * *

The new headquarters of the Decca group of companies at Decca House, 9 Albert Embankment, London, S.E.11, were officially opened by the President of the Board of Trade, Sir David Eccles, on March 10.

* * *

Simmonds Aerocessories of Canada, Ltd., and their associate company, Simmonds Products of Canada, Ltd., have transferred their activities from Montreal to new and larger premises at 637 Parkdale Avenue North, Hamilton, Ont. (tel. Liberty 9-1381).

* * *

Soundrite, Ltd., electro-acoustic engineers and audio consultants, 83 New Bond Street, London, W.1, have been appointed sole U.K. distributors and agents for the American corporations Altec Lansing and Stancil Hoffman.

Mr. H. J. H. Wassell, O.B.E., B.Sc. (left), formerly chief radar engineer of Marconi's Wireless Telegraph Co., Ltd., who has been appointed manager of a new test department set up within the company to co-ordinate and control all test and inspection activities. He is succeeded as chief radar engineer by Mr. J. K. Todd, M.A., A.M.I.E.E. (right), who since 1956 has been head of the missile radar research group at the Marconi research laboratories.

A special type of towel, known as the C-Fold, is supplied by Hi-Dri (Industrial Division of Kimberly-Clark, Ltd., 11 Grosvenor Gardens, London, S.W.1) for use in aircraft. It is made up in cartons containing 4,000 individual towels in packets of 50, the towels being dispensed from cream cabinets (each holding 200) which are supplied free on loan. Hi-Dri representatives install these cabinets without charge and advise on positioning.

* * *

Two fellowships have been sponsored by Wilmot Breedon, Ltd., one at the University of Birmingham and the other at the College of Technology, Birmingham. Each is worth £1,000 per annum and normally will be held for a period of two years, successful candidates dividing their time between the University or College and the company. Applicants (who would be expected to have had two or three years' industrial or research experience and to hold an honours degree or its equivalent) should write to the Secretary, Wilmot Breedon (Holdings), Ltd., Amington Road, Birmingham, 25. Other news from Wilmot Breedon is that Mr. G. Selwood, lately chief designer (hydraulics) at Fairey Aviation, has joined them as chief engineer.

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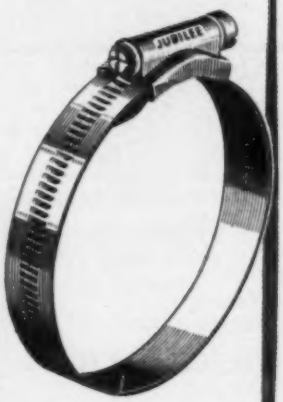

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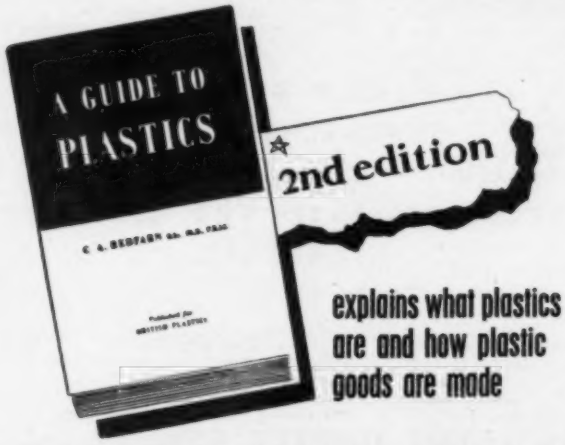

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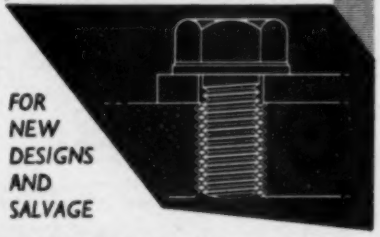

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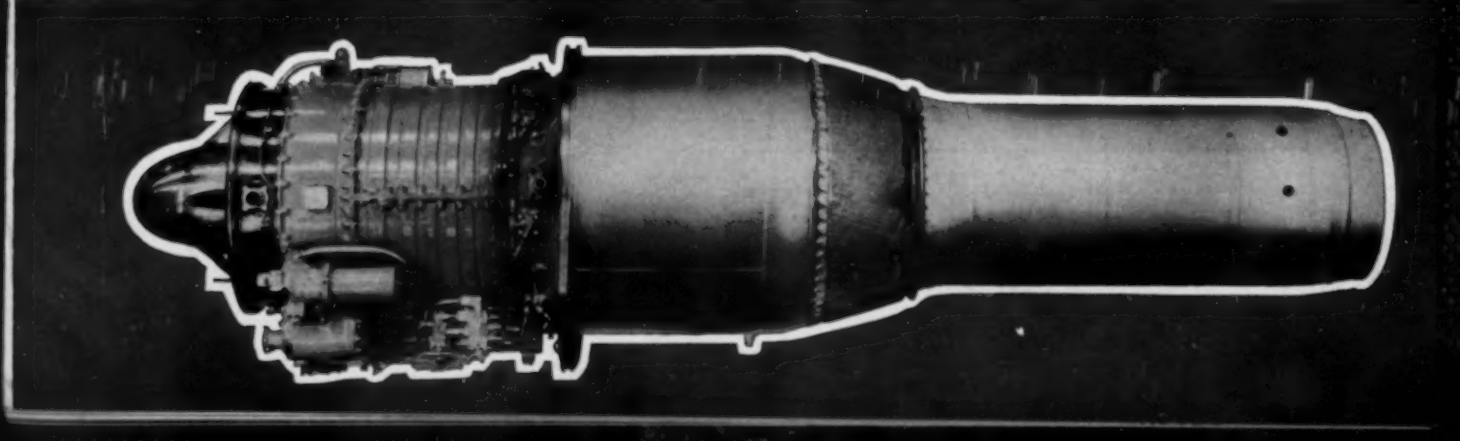
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